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Suh et al.

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(54) **LIGHT EMITTING ELEMENT**

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Jan. 23, 2015	(KR)	10-2015-0011070
Jun. 26, 2015	(KR)	10-2015-0091492

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H01L 33/24 (2010.01)
H01L 33/42 (2010.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H01L 33/24*** (2013.01); ***H01L 24/05*** (2013.01); ***H01L 24/48*** (2013.01); ***H01L 33/145*** (2013.01);

(Continued)

(58) **Field of Classification Search**

CPC H01L 33/24; H01L 33/42; H01L 33/387; H01L 33/382; H01L 33/38; H01L 33/22;

(Continued)

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(57) **ABSTRACT**

The light emitting element is provided to comprise: a first conductive type semiconductor layer; a mesa; a current blocking layer; a transparent electrode; a first electrode pad and a first electrode extension; a second electrode pad and a second electrode extension; and an insulation layer partially located on the lower portion of the first electrode, wherein the mesa includes at least one groove formed on a side thereof, the first conductive type semiconductor layer is partially exposed through the groove, the insulation layer includes an opening through which the exposed first conductive type semiconductor layer is at least partially exposed, the first electrode extension includes extension contact portions in contact with the first conductive type semiconductor layer through an opening, and the second

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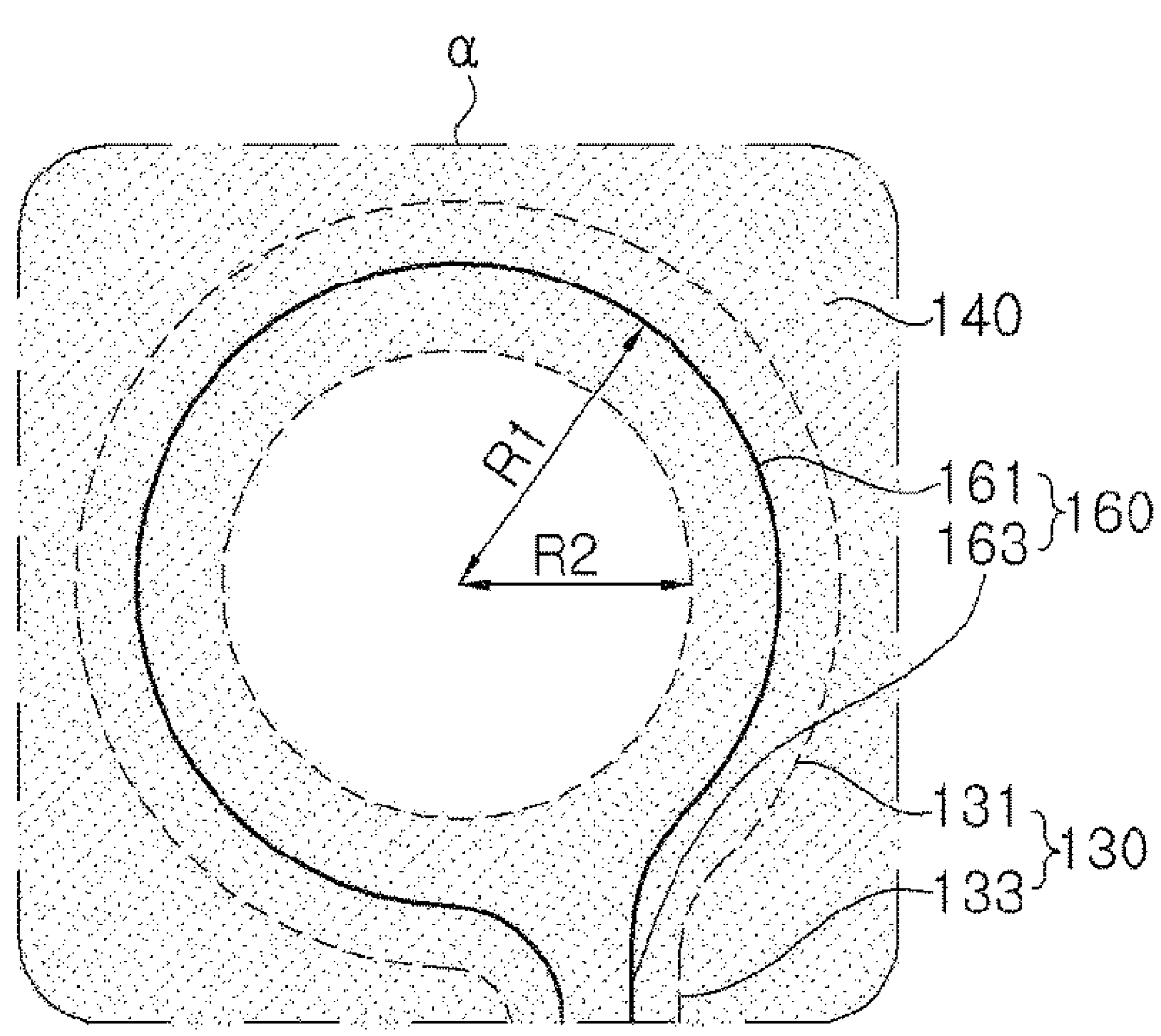

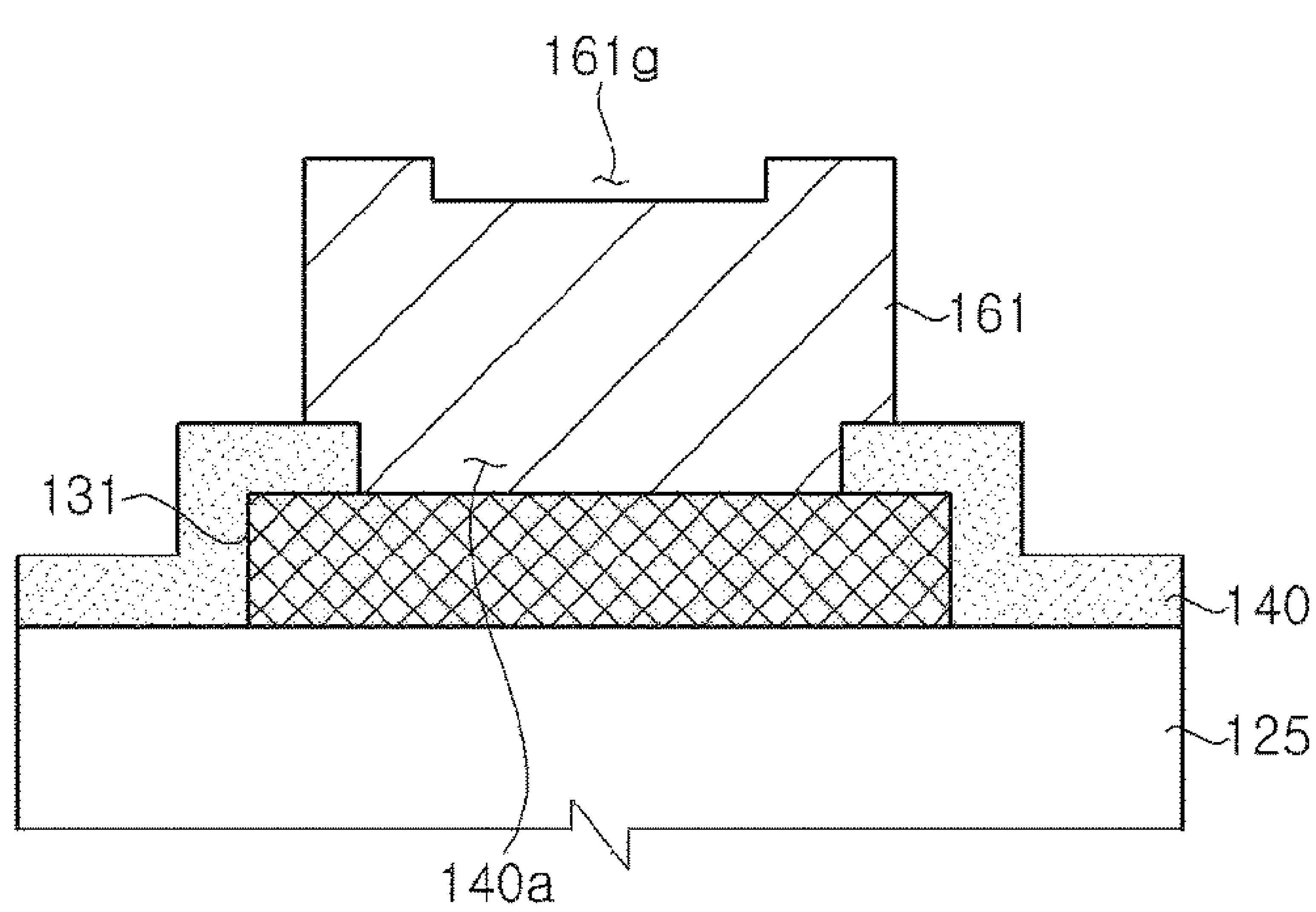

electrode extension includes an end with a width different from the average width of the second electrode extension.

17 Claims, 12 Drawing Sheets

Related U.S. Application Data

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(51) **Int. Cl.**

H01L 33/38	(2010.01)
H01L 33/22	(2010.01)
H01L 33/14	(2010.01)
H01L 23/00	(2006.01)

(52) **U.S. Cl.**

CPC ***H01L 33/22*** (2013.01); ***H01L 33/38*** (2013.01); ***H01L 33/382*** (2013.01); ***H01L 33/387*** (2013.01); ***H01L 33/42*** (2013.01); *H01L 2224/48091* (2013.01); *H01L 2224/48453* (2013.01); *H01L 2224/48465* (2013.01); *H01L 2924/00014* (2013.01)

(58) **Field of Classification Search**

CPC H01L 33/145; H01L 24/48; H01L 24/05; H01L 2924/00014; H01L 2224/48465; H01L 2224/48453; H01L 2224/48091

See application file for complete search history.

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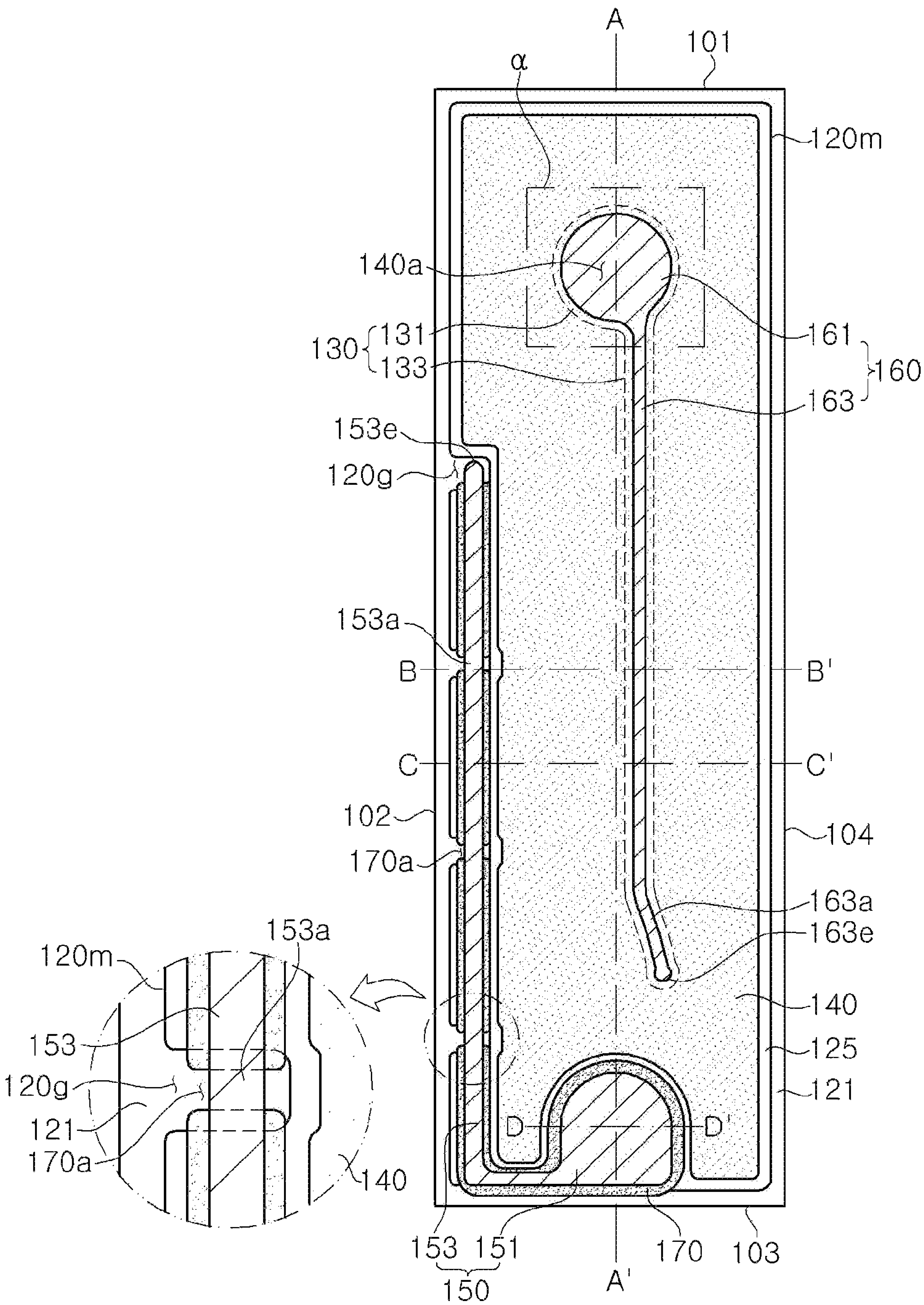
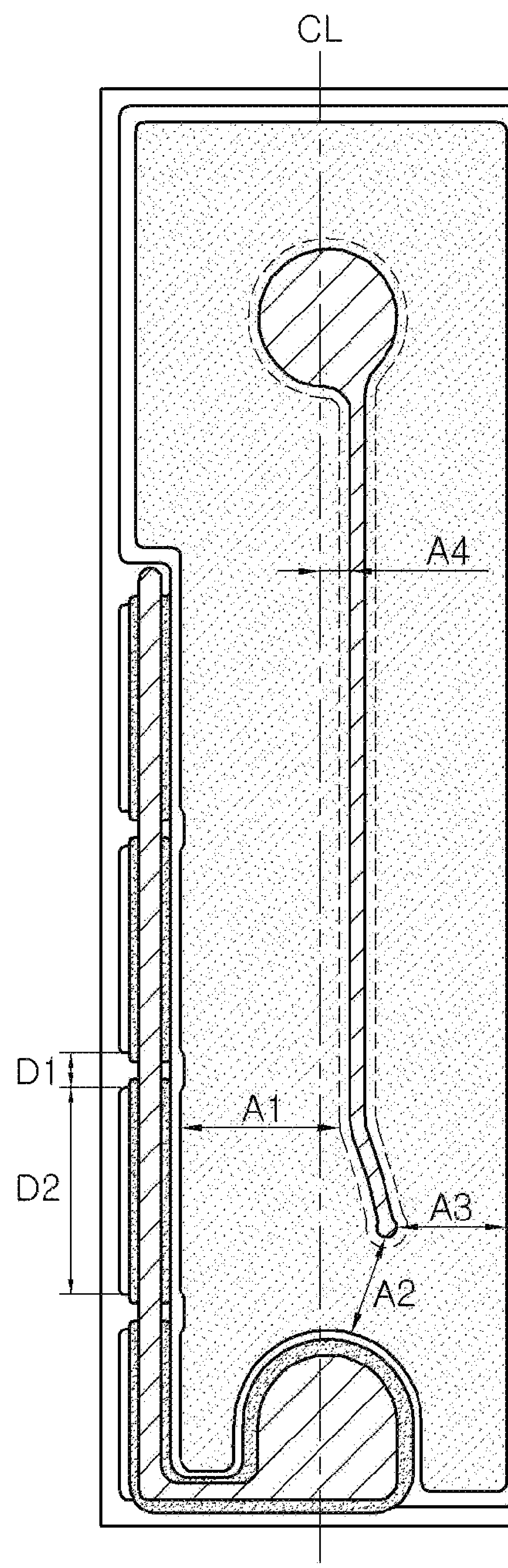
FIG. 1A



A
101
α
120m
140a
130
131
133
161
160
163
153e
120g
153a
B
B'
C
C'
102
104
170a
163a
163e
120m
153a
140
153
125
120g
121
121
170a
140
D
D'
153
151
170
103
150
A'

FIG. 1B



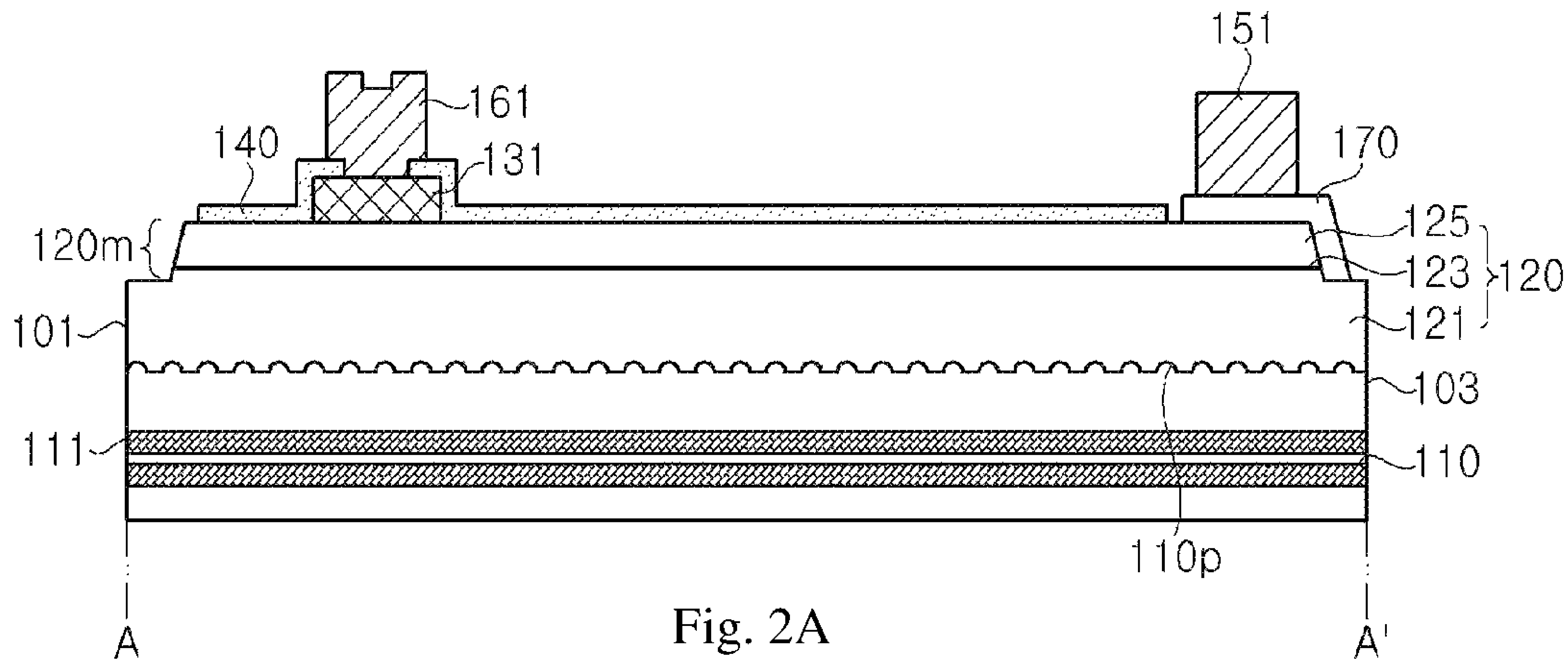


Fig. 2A

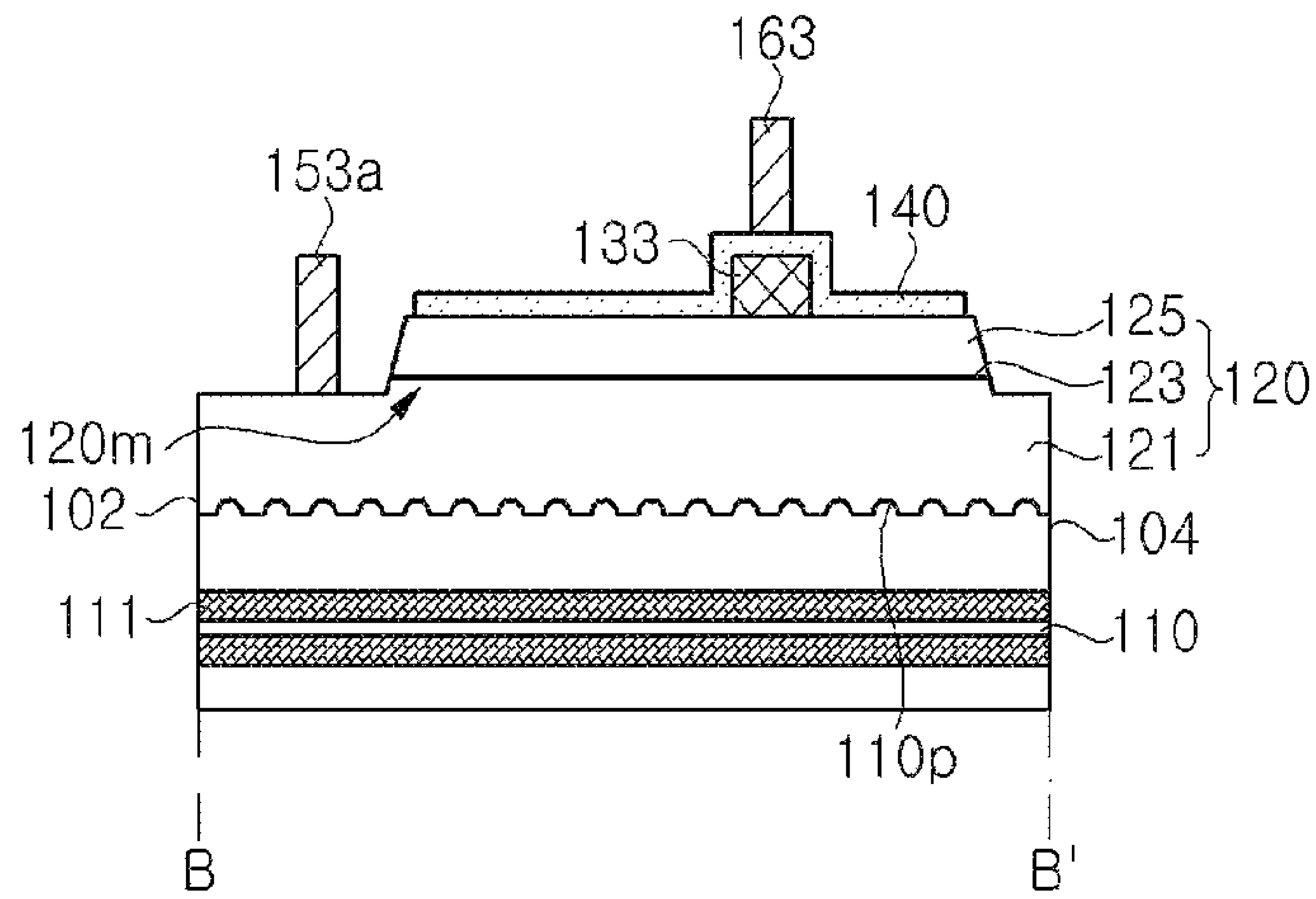


Fig. 2B

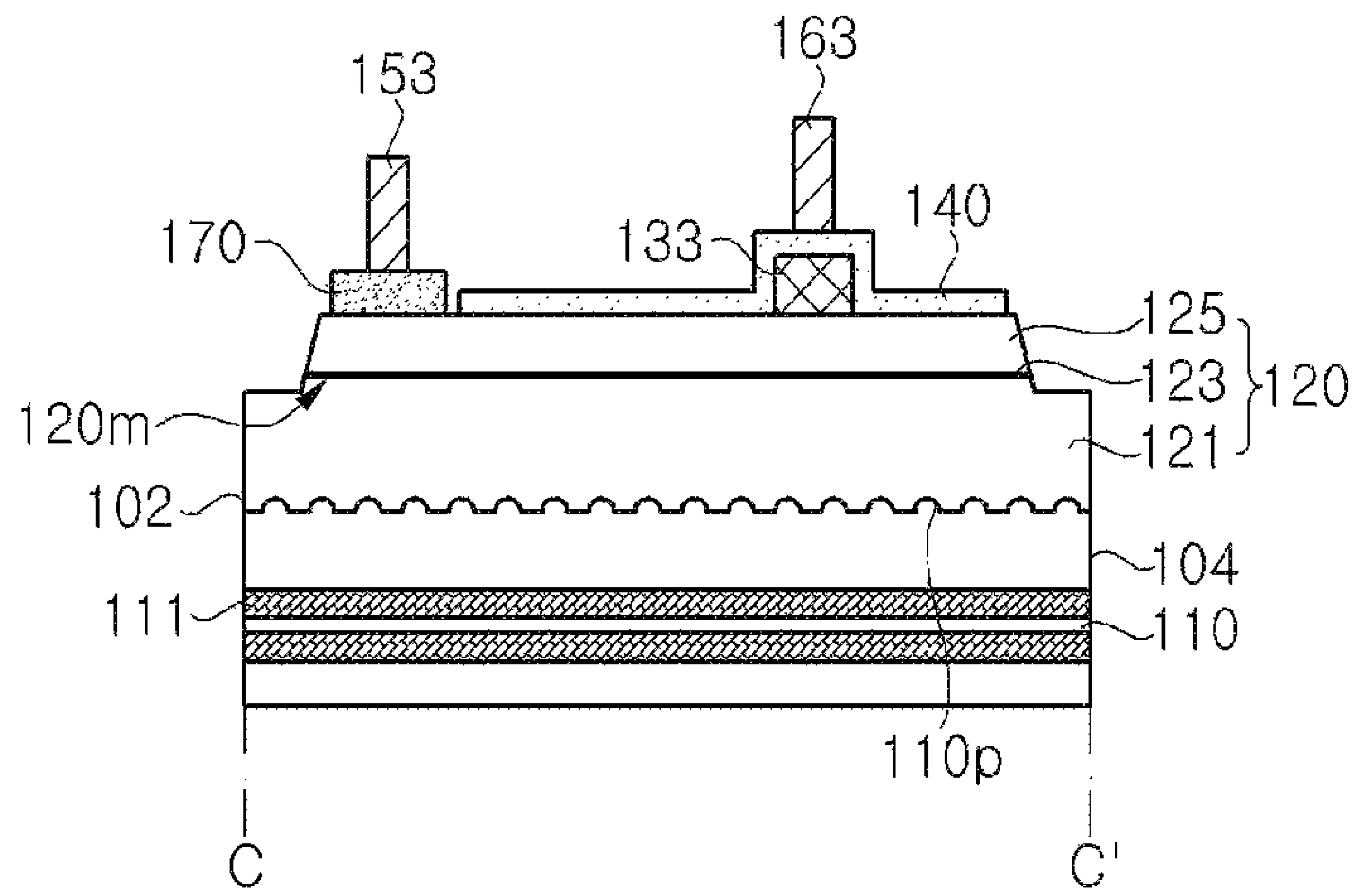


Fig. 2C

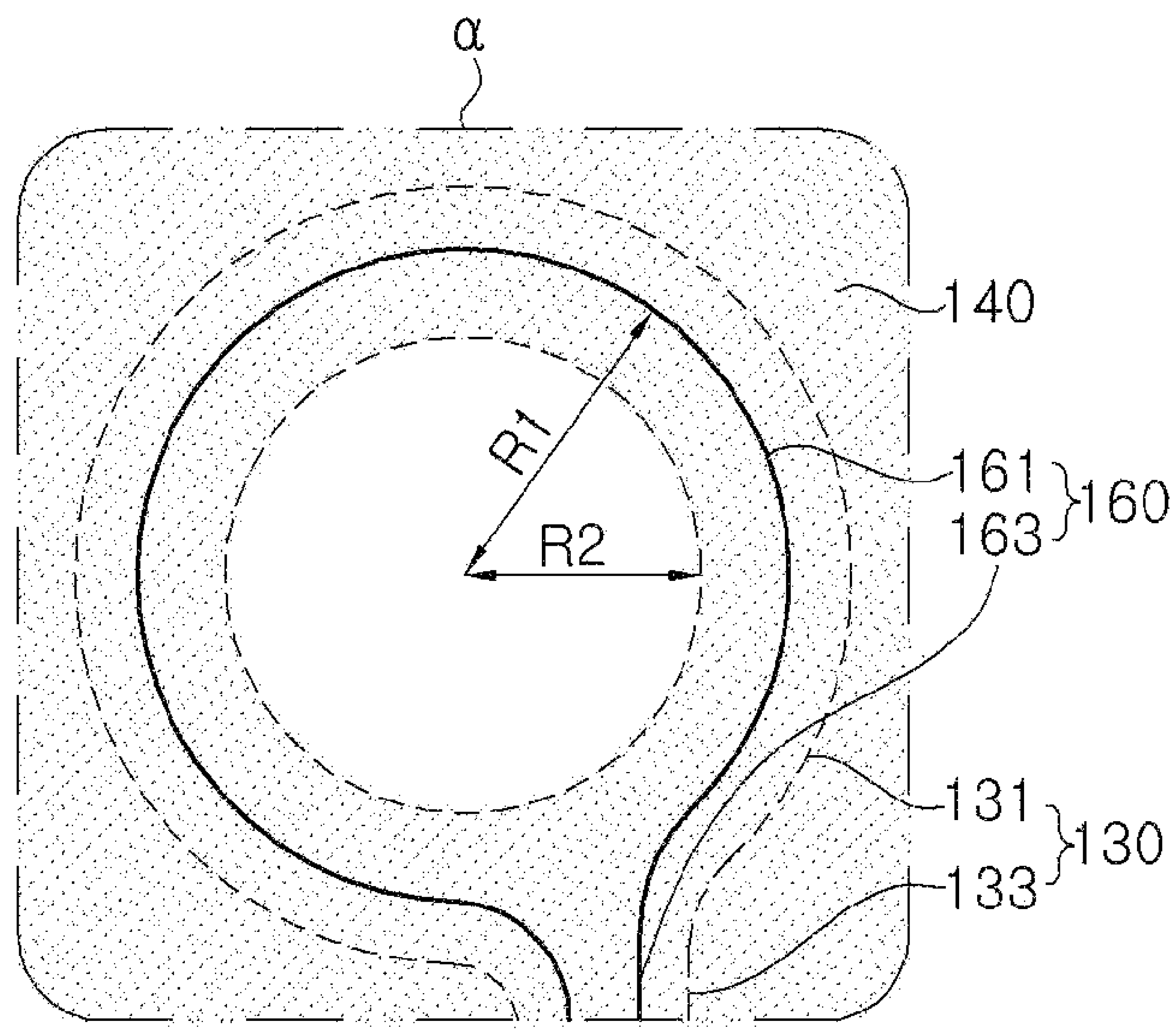


Fig. 3A

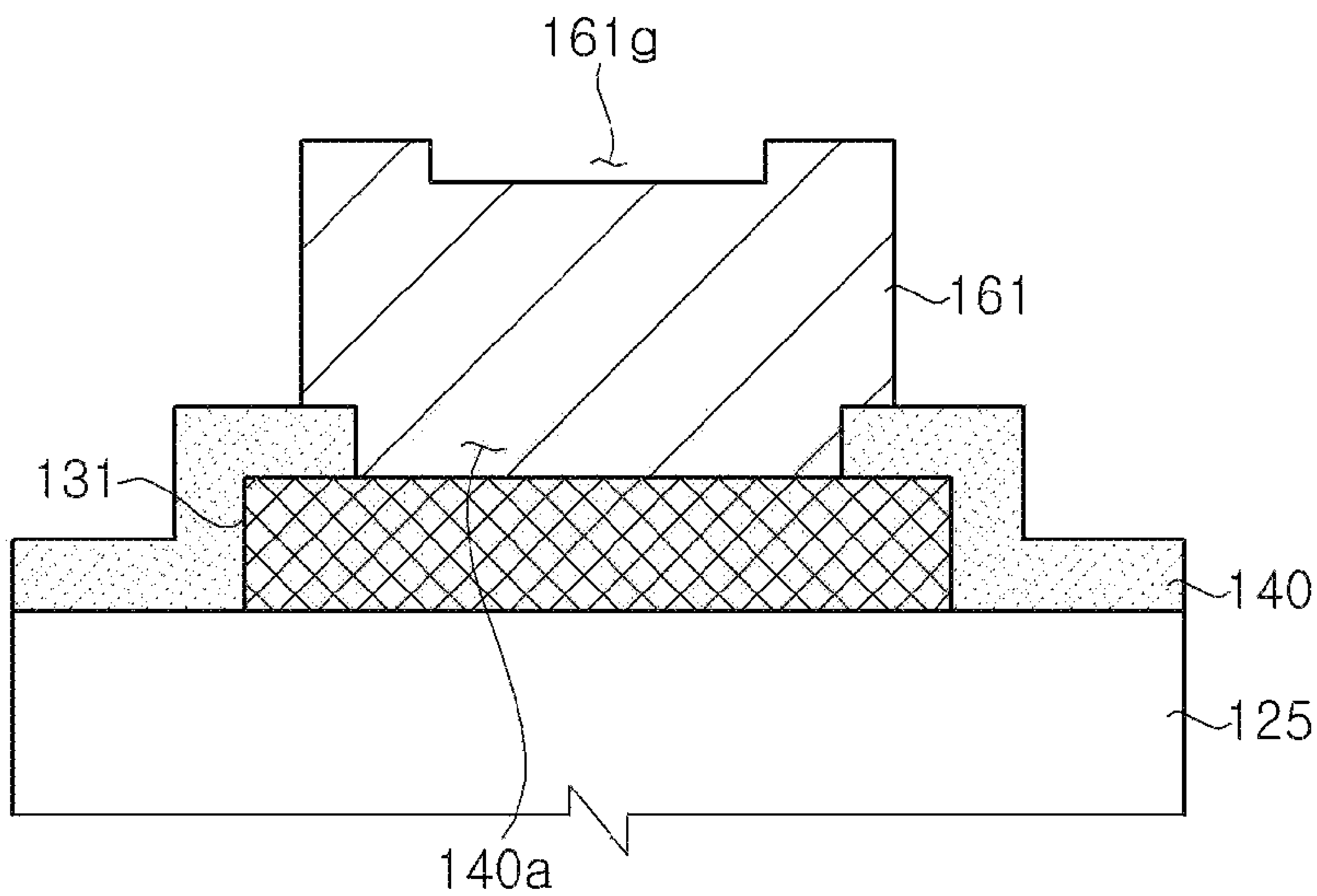
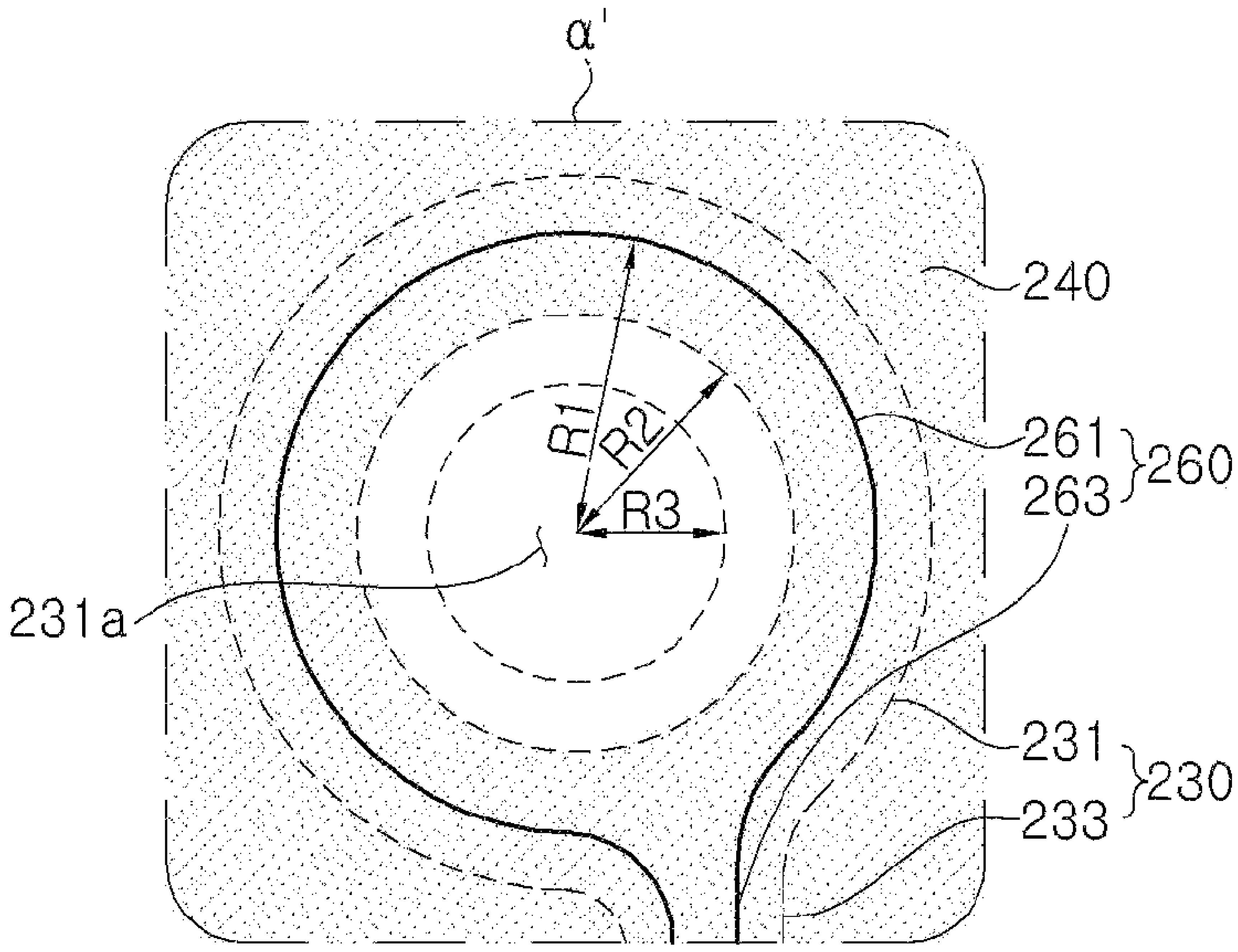


Fig. 3B


α'
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260
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R2
R3
231a
231
233
230

Fig. 4A

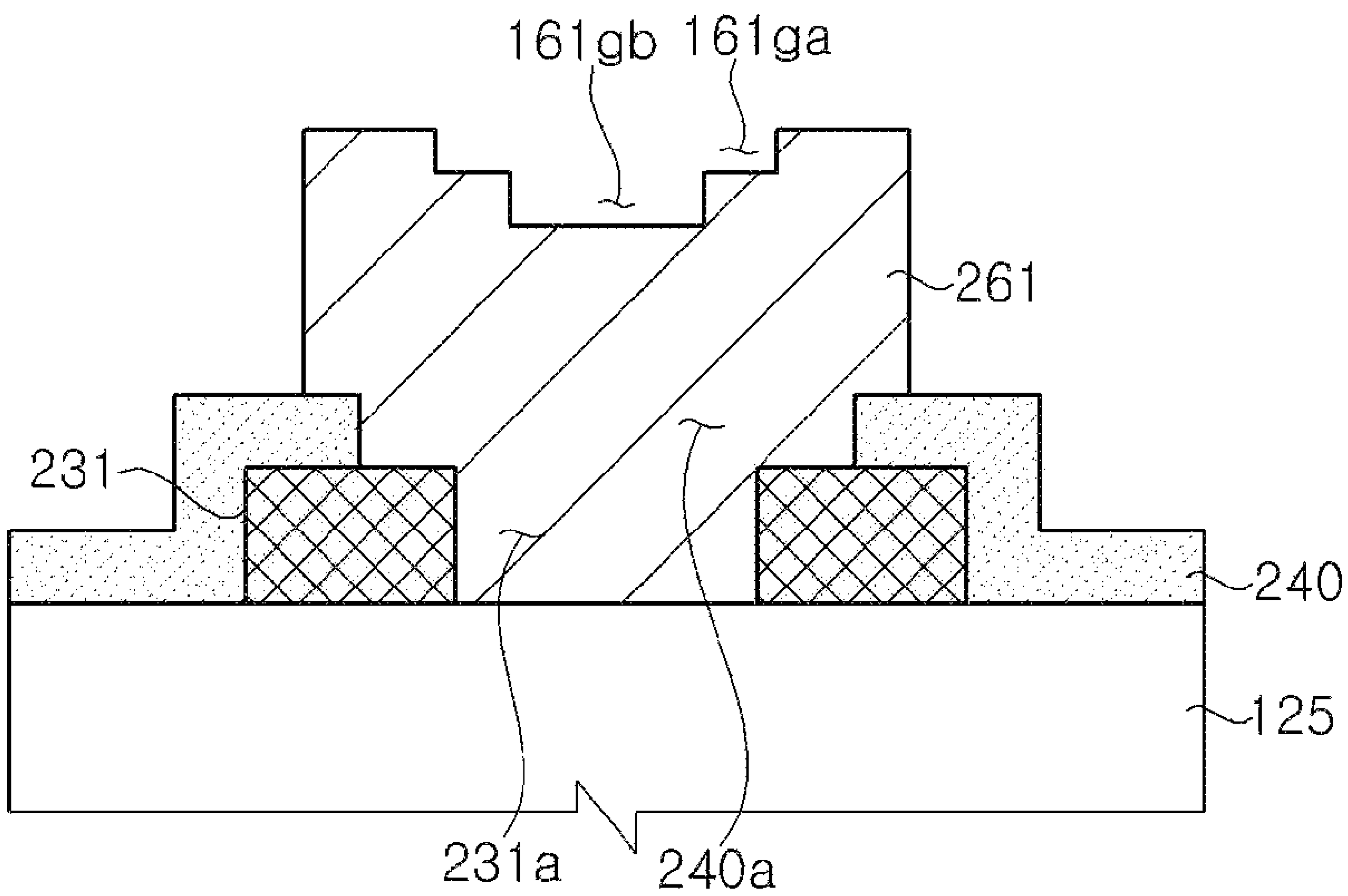
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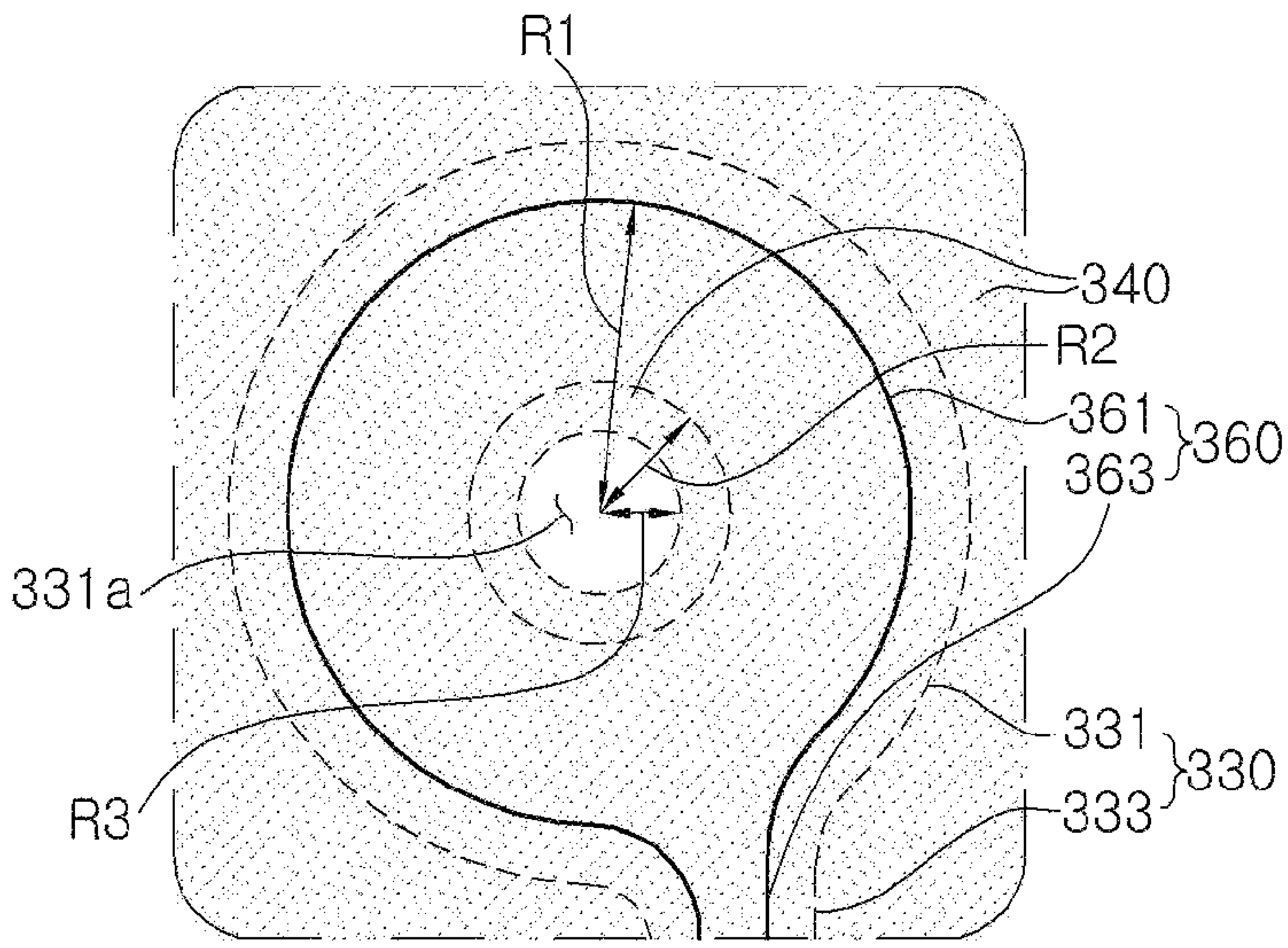
Fig. 4B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R3
333

Fig. 5A

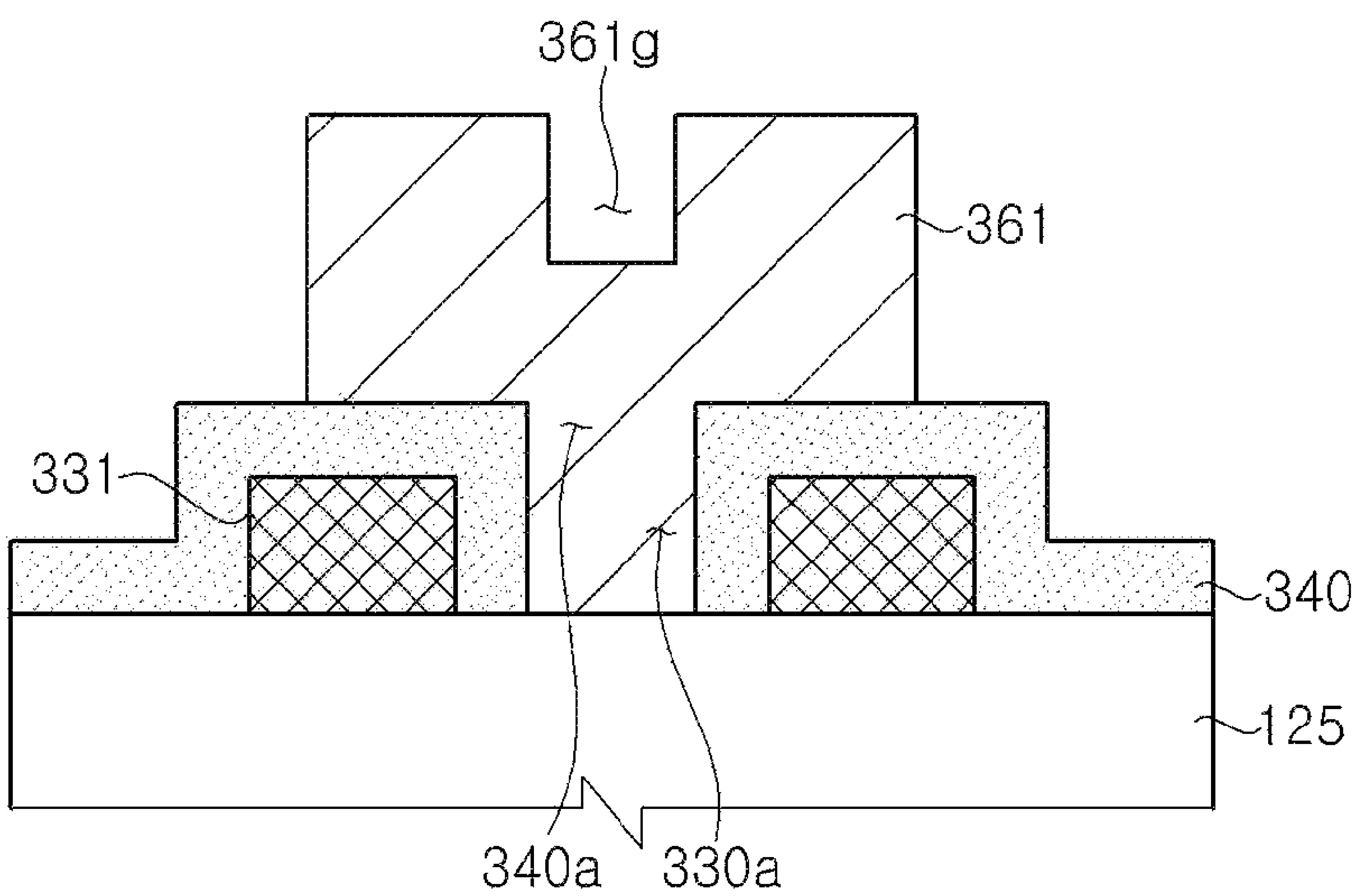
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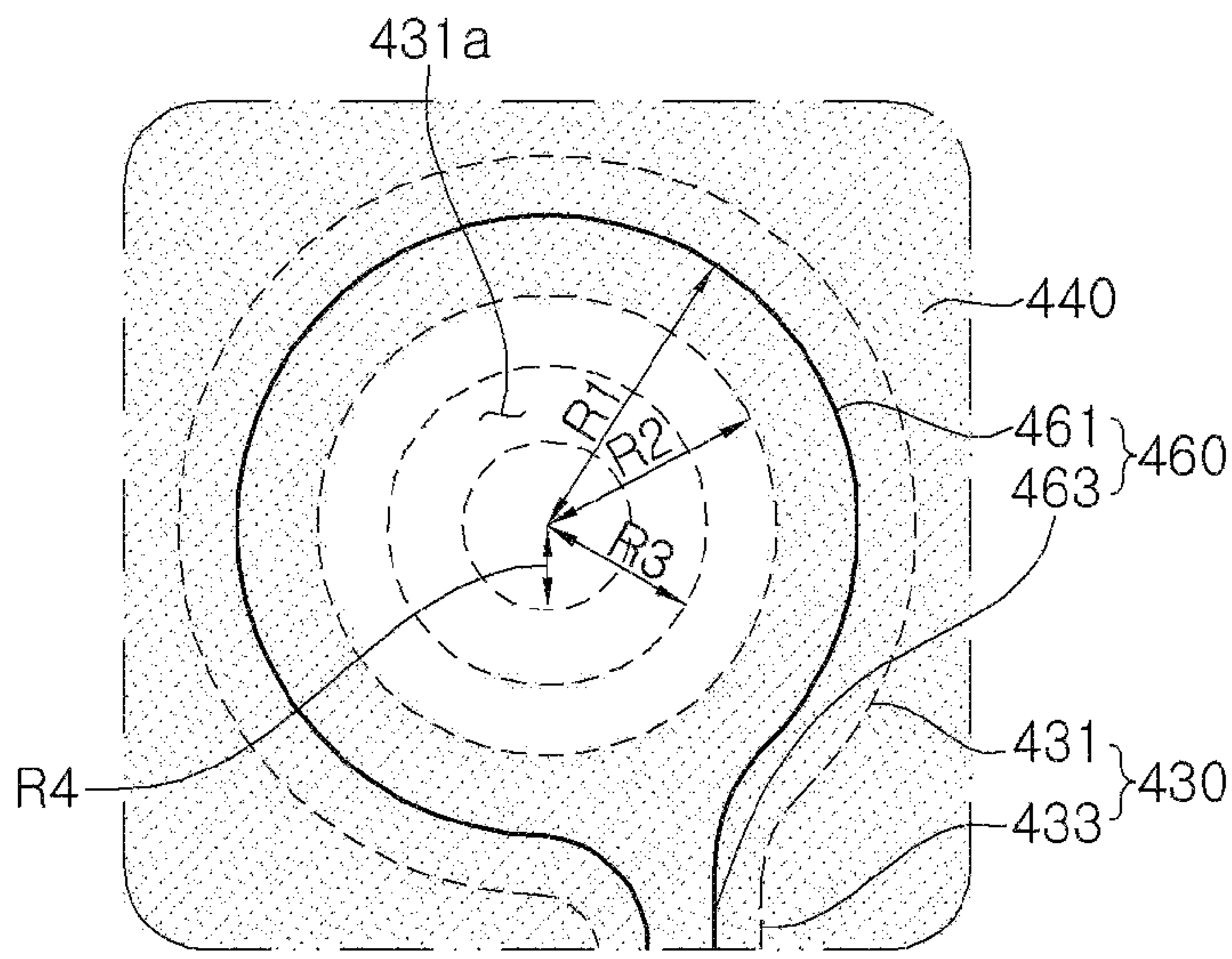
Fig. 5B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R1
R2
R3
R4
431
430
433

Fig. 6A

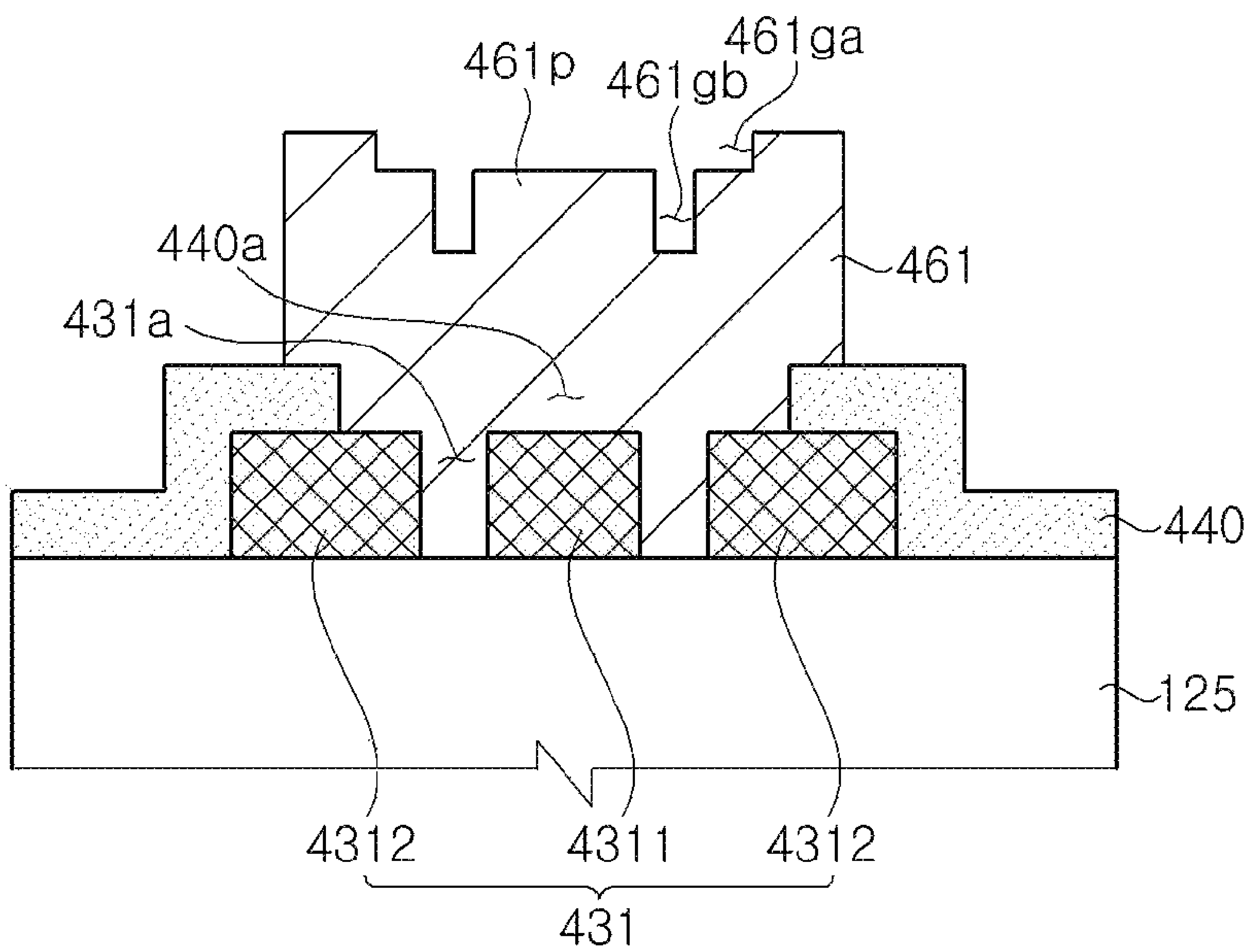
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Fig. 6B

FIG. 7

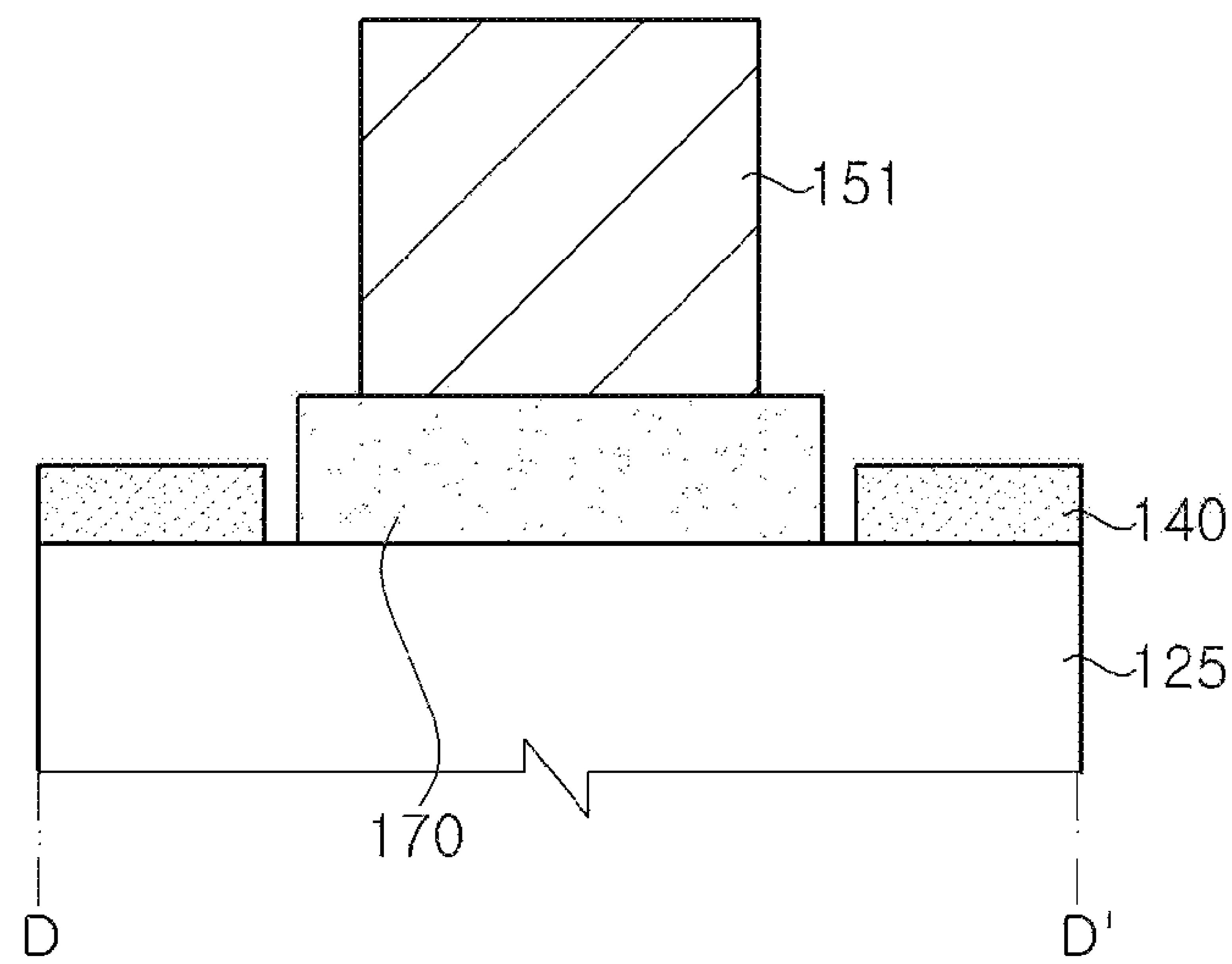
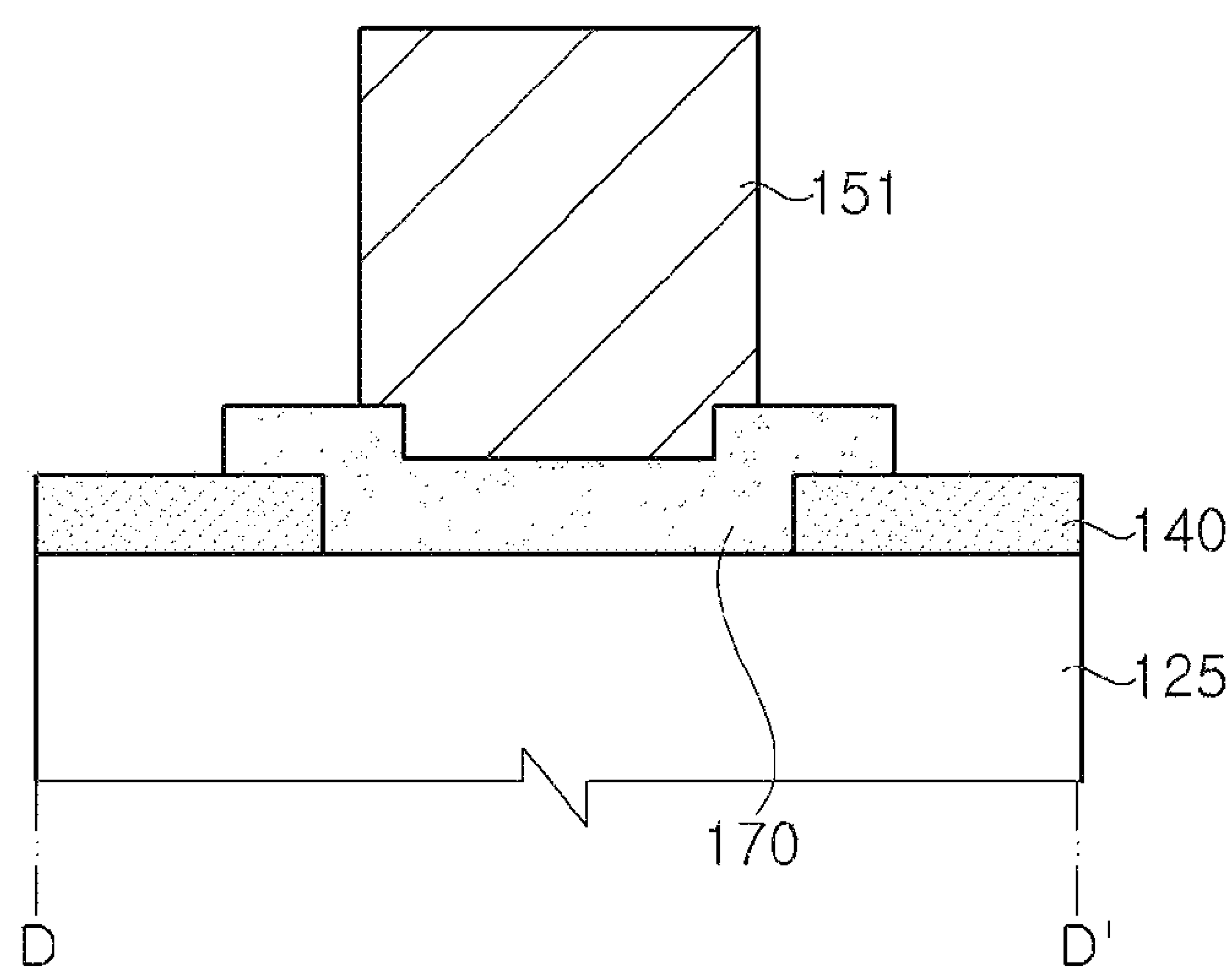


FIG. 8



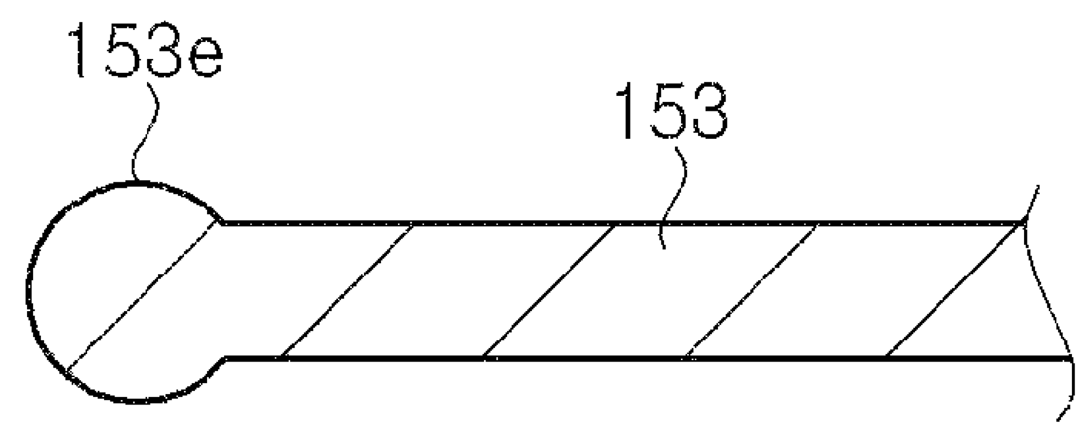


Fig. 9A

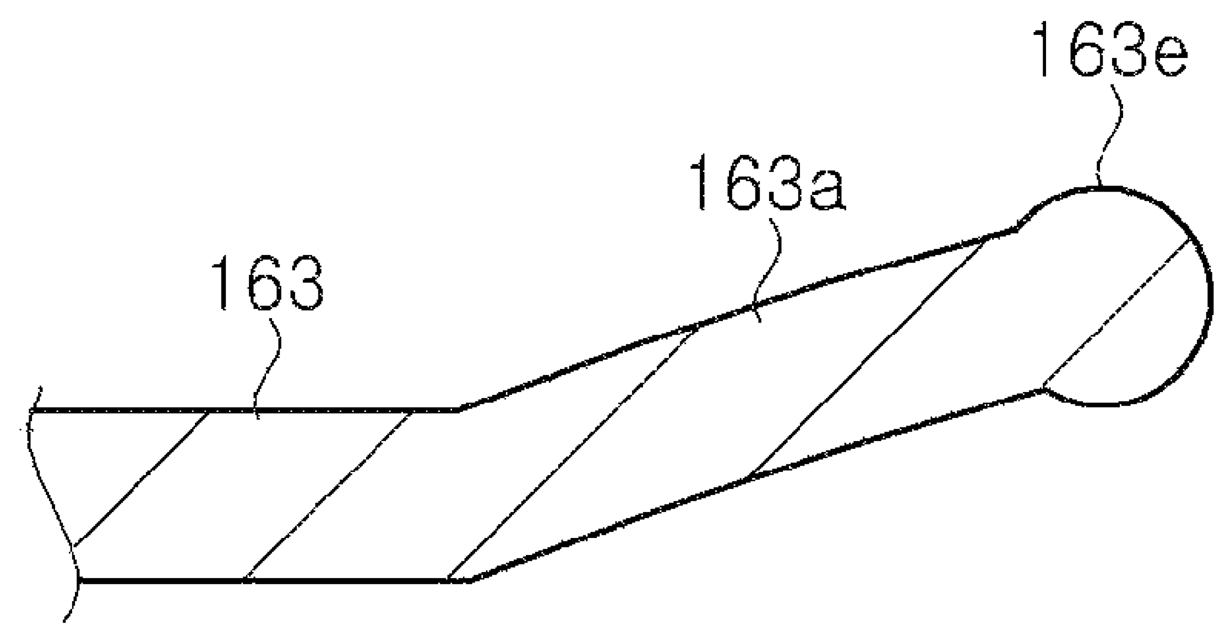


Fig. 9B

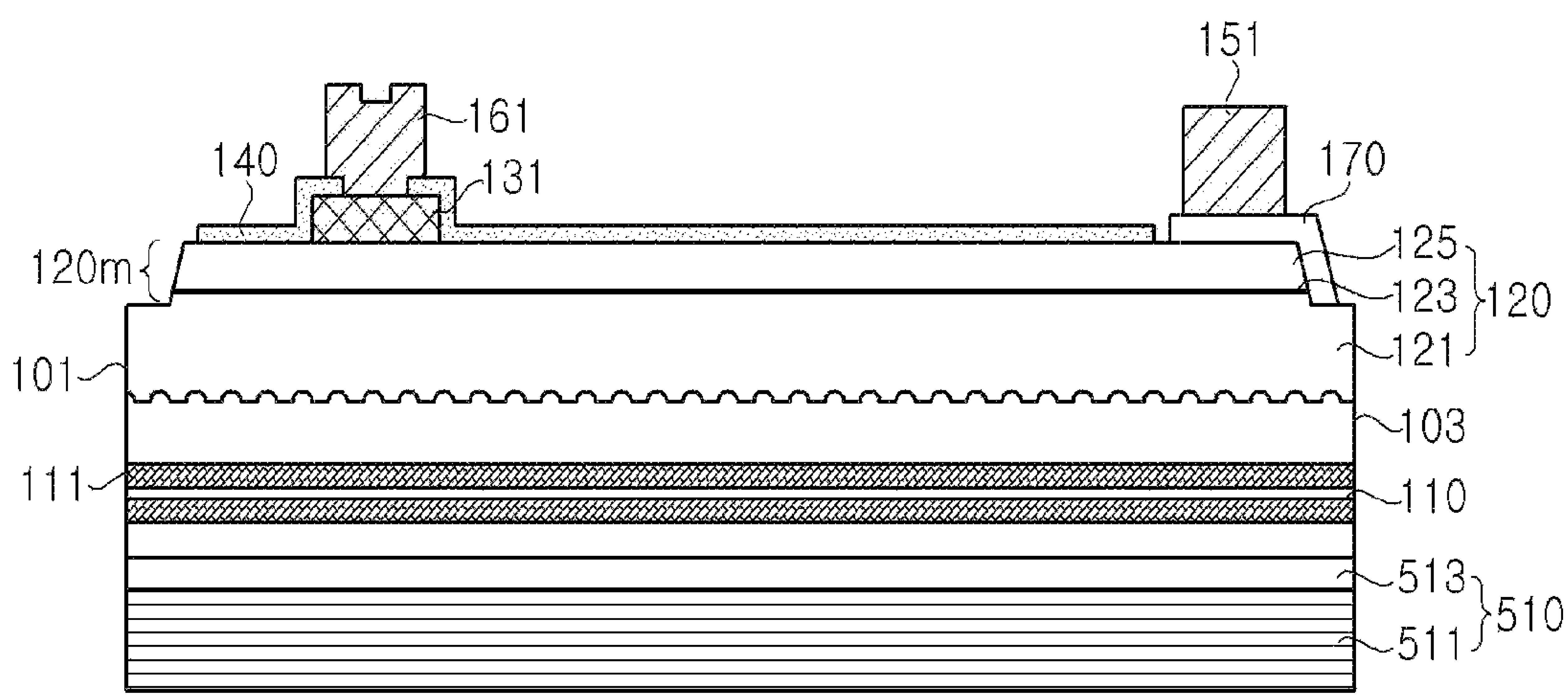
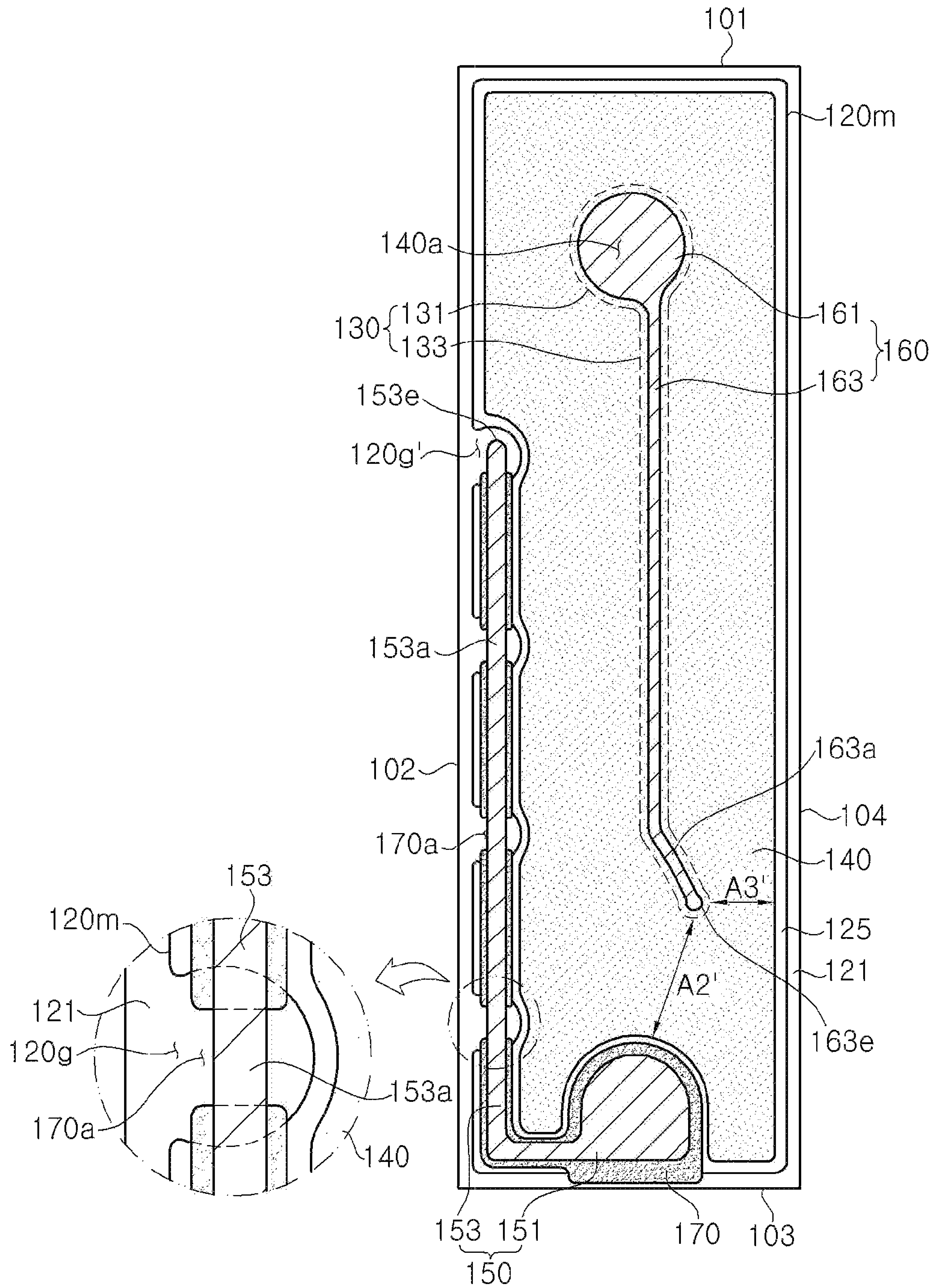


FIG. 10

FIG. 11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170
103
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FIG. 12

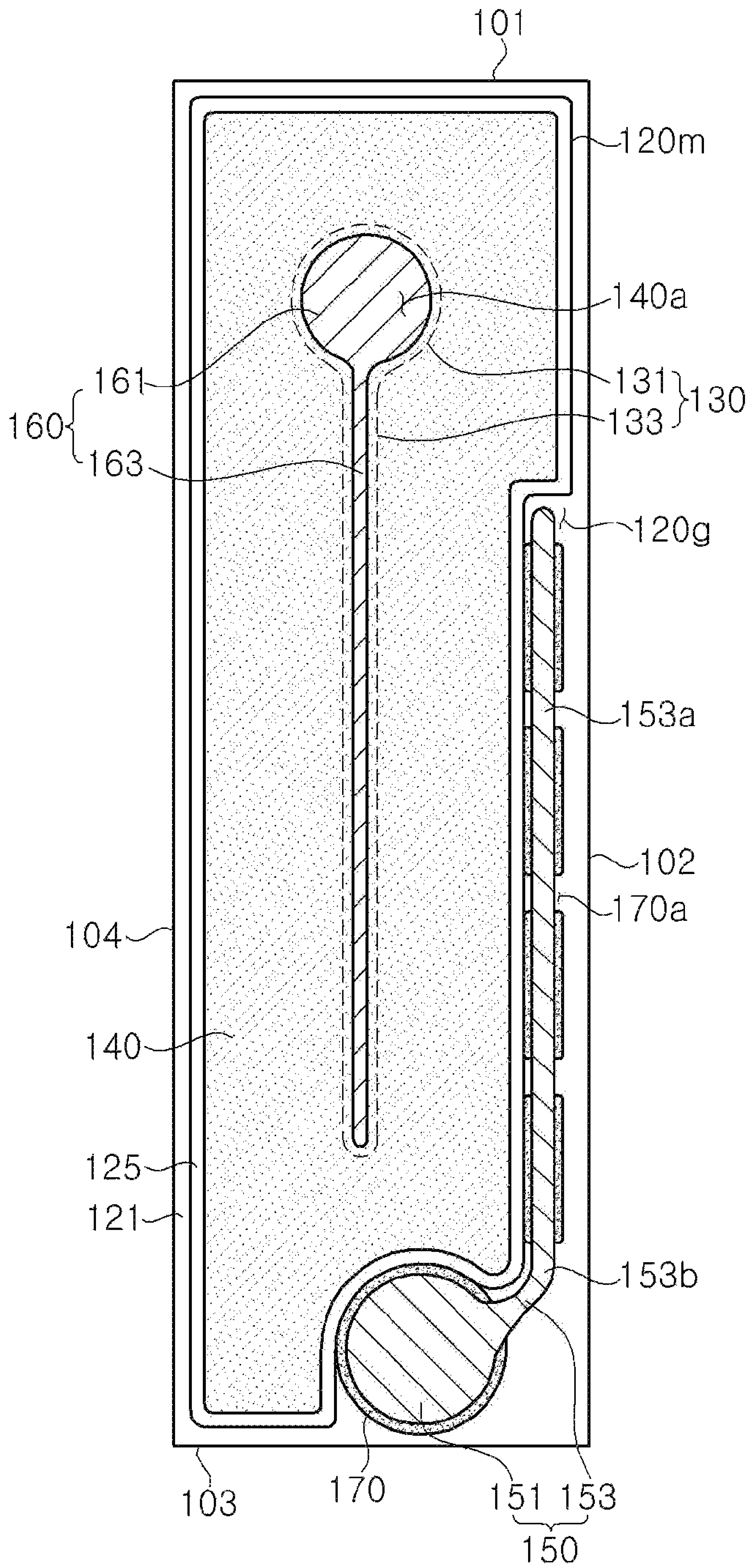
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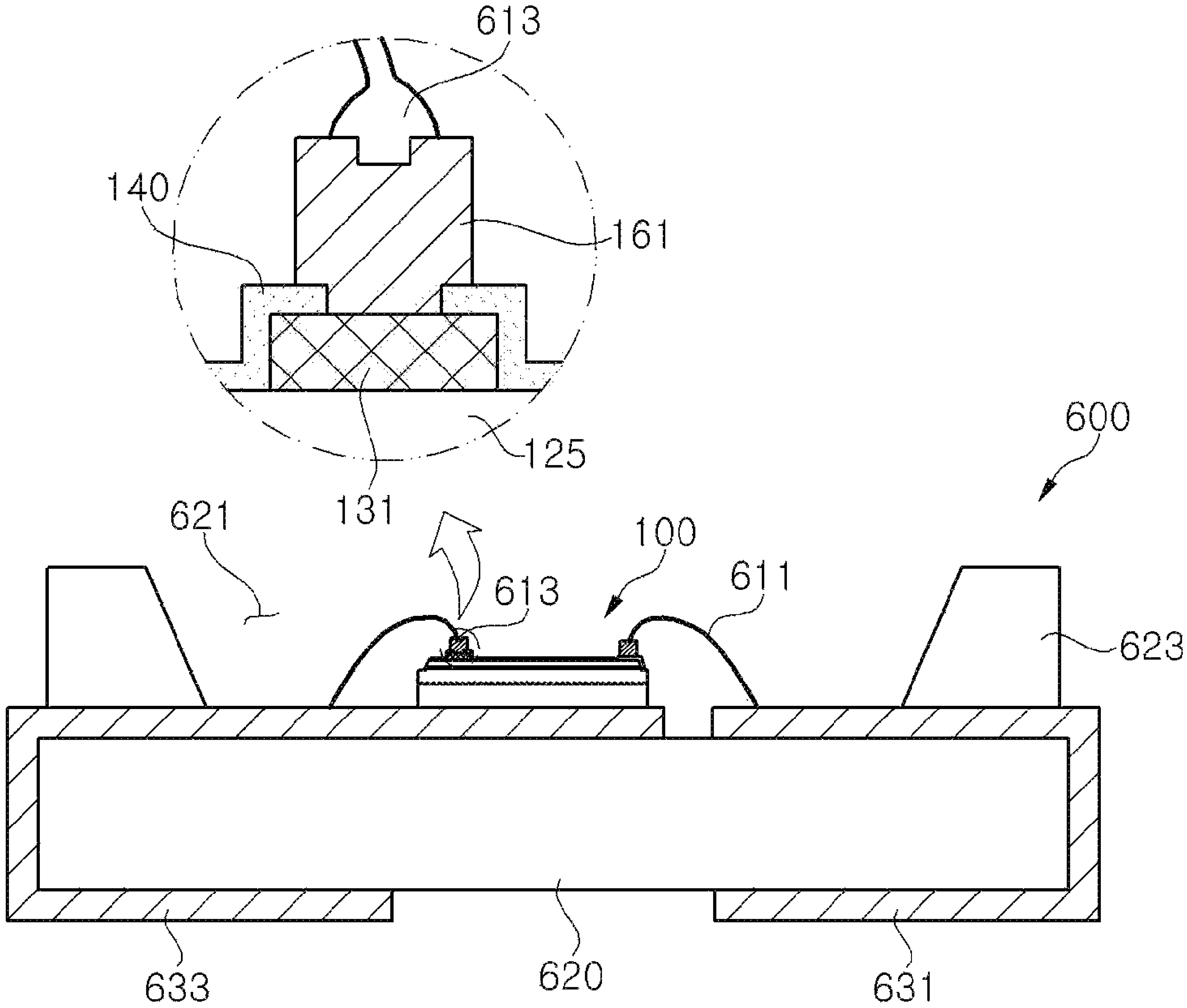
FIG. 13



LIGHT EMITTING ELEMENT

CROSS-REFERENCES TO RELATED APPLICATIONS

This patent document is a continuation of, and claims the benefit of priority to, U.S. patent application Ser. No. 15/394,333, filed on Dec. 29, 2016, which is a 371 of International Patent Application No. PCT/KR2015/006787, filed on Jul. 1, 2015, which claims further priority to Korean Patent Application No. 10-2015-0091492, filed on Jun. 26, 2015, Korean Patent Application No. 10-2015-0011070, filed on Jan. 23, 2015, and Korean Patent Application No. 10-2014-0082014, filed on Jul. 1, 2014, which are hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND

Exemplary embodiments described in this document relate to a light emitting device. For example, some embodiments of the present document relate to a light emitting device that has high current spreading efficiency to provide good properties in terms of luminous efficacy and reliability.

Generally, a light emitting device such as a light emitting diode includes an n-type semiconductor layer supplying electrons, a p-type semiconductor layer supplying holes, and an active layer interposed between the n-type semiconductor layer and the p-type semiconductor layer. An n-type and a p-type electrode are formed on the n-type semiconductor layer and the p-type semiconductor layer, respectively, to receive electric power from an external power source.

On the other hand, a nitride semiconductor-based p-type semiconductor layer has lower electrical conductivity than the n-type semiconductor layer. As a result, electric current is not efficiently spread in the p-type semiconductor layer, thereby causing current crowding in a certain region of the semiconductor layer. When current crowding occurs in the semiconductor layer, a light emitting diode becomes vulnerable to electrostatic discharge and can suffer from current leakage and efficiency droop. In order to achieve efficient current spreading, a transparent electrode such as an indium tin oxide (ITO) electrode is formed on the p-type semiconductor layer and the p-type electrode is formed on the ITO layer.

SUMMARY

Exemplary embodiments disclosed in the present document provide a light emitting device configured to achieve uniform current spreading in a horizontal direction.

Exemplary embodiments disclosed in the present document provide a light emitting device that includes a second electrode, a transparent electrode and a current blocking layer correlatively connected to one another to improve structural and electrical reliability.

Exemplary embodiments disclosed in the present document provide a light emitting device having improved bondability of wire bonding.

In accordance with one aspect, a light emitting device includes: a first conductive type semiconductor layer; a mesa disposed on the first conductive type semiconductor layer and including an active layer and a second conductive type semiconductor layer disposed on the active layer; a current blocking layer partially disposed on the mesa; a transparent electrode disposed on the mesa and at least partially covering the current blocking layer; a first electrode insulated from the second conductive type semiconductor layer, and including a first electrode pad and a first electrode extension portion extending from the first electrode pad; a second electrode disposed on the current blocking layer to be electrically connected to the transparent electrode, and including a second electrode pad and a second electrode extension portion extending from the second electrode pad; and an insulation layer partially disposed in a region under the first electrode, wherein the mesa includes at least one groove formed on a side surface thereof such that the first conductive type semiconductor layer is partially exposed through the groove; the insulation layer includes an opening at least partially exposing the exposed first conductive type semiconductor layer; the first electrode extension portion includes at least one extension contact portion contacting the first conductive type semiconductor layer through the opening; and the second electrode extension portion includes a distal end having a different width than an average width of the second electrode extension portion.

In some implementations, the width of the distal end of the second electrode extension portion may be greater than the average width of the second electrode extension portion.

In some implementations, the distal end of the second electrode extension portion may have a circular shape, a diameter of which is greater than a width of the second electrode extension portion.

In some implementations, the second electrode extension portion may include an additional extension portion bent from an extension direction of the second electrode extension portion, and the additional extension portion may be bent away from the first electrode extension portion.

In some implementations, the additional extension portion may be formed in a curved shape having a predetermined curvature.

In some implementations, the additional extension portion may be bent towards one corner of the light emitting device.

In some implementations, the first electrode pad and the second electrode pad may be disposed on a longitudinal line passing through a center of the light emitting structure; the first electrode pad may be disposed adjacent to a first side surface of the light emitting device; and the second electrode pad may be disposed adjacent to a third side surface of the light emitting device opposite the first side surface thereof.

In some implementations, the first electrode extension portion may extend towards the first side surface along a second side surface of the light emitting device disposed between the first side surface and the third side surface thereof; and the second electrode extension portion may be disposed closer to a fourth side surface of the light emitting device opposite the second side surface thereof than the second side surface thereof and may extend towards the third side surface thereof.

In some implementations, the shortest distance from the second electrode pad to the fourth side surface of the light emitting device may be the same as the shortest distance from the distal end of the second electrode extension portion to the fourth side surface thereof.

In some implementations, the opening of the insulation layer may include a plurality of openings arranged at constant intervals along the second side surface and the openings.

In some implementations, the shortest distance from the first electrode extension portion to the second electrode extension portion may be greater than a distance from the distal end of the second electrode extension portion to the first electrode pad.

In some implementations, a distance between the openings of the insulation layer may be three or more times a width of the opening of the insulation layers exposing the groove.

In some implementations, the current blocking layer may include a pad-current blocking layer disposed under the second electrode pad and an extension portion-current blocking layer disposed under the second electrode extension portion.

In some implementations, the transparent electrode may include a first opening disposed on the pad-current blocking layer; the second electrode pad may be disposed on the pad-current blocking layer to fill the first opening while partially covering the transparent electrode disposed on the pad-current blocking layer; and an upper surface of the second electrode pad may have a surface profile corresponding to an upper surface of the pad-current blocking layer and an upper surface of the transparent electrode disposed on the current blocking layer.

In some implementations, the pad-current blocking layer may include a second opening exposing the second conductive type semiconductor layer; the second electrode may contact the second conductive type semiconductor layer through the second opening; the second opening may be disposed in a region of the first opening; and an upper surface of the second electrode may include a first depression disposed corresponding to the first opening and a second depression disposed corresponding to the second opening.

In some implementations, the pad-current blocking layer may include a first region surrounded by the second opening and a second region surrounding the second opening; and an upper surface of the second electrode may include a protrusion protruding from a lower surface of the second depression and disposed in the first region of the pad-current blocking layer.

In some implementations, the insulation layer may be disposed on the mesa; the mesa may include at least one groove formed on a side surface thereof such that the first conductive type semiconductor layer is partially exposed through the groove; and the opening of the insulation layer may at least partially expose the first conductive type semiconductor layer exposed through the groove.

In some implementations, the first electrode pad and the first electrode extension portion may be disposed on the mesa and the extension portion-contact portion may form ohmic contact with the first conductive type semiconductor layer exposed through the groove.

In some implementations, the insulation layer may be disposed on the first conductive type semiconductor layer, and the extension portion-contact portion may include a first extension portion-contact portion and a second extension portion-contact portion, wherein the first extension portion-contact portion may be disposed along one side surface of the mesa and the second extension portion-contact portion may be disposed near one corner of the mesa so as to be adjacent to the first electrode pad.

In some implementations, the substrate may include a plurality of modification regions formed on at least one side surface thereof and having a strap shape extending in a horizontal direction thereof, and a distance between a lowermost modification region and a lower surface of the substrate may be smaller than a distance between an uppermost modification region and an upper surface of the substrate.

According to the exemplary embodiments, the light emitting device includes a first electrode pad disposed in a central region of a light emitting structure in the longitudinal direction of the light emitting structure, thereby improving efficiency of an electrode formation process, a packaging process, and the like.

According to the exemplary embodiments, the light emitting device includes a first electrode extension portion that contacts the first conductive type semiconductor layer through a contact point, thereby minimizing lateral light loss while improving current spreading efficiency.

In the light emitting device according to the exemplary embodiments, a second electrode extension portion has an additional extension portion formed in a curved shape, and thus can be formed as long as possible while maintaining a distance between the second electrode extension portion and a first electrode pad, thereby preventing current crowding at a distal end of the second electrode extension portion.

In the light emitting device according to the exemplary embodiments, a second electrode pad is disposed on a transparent electrode having an opening, and a portion of the transparent electrode is interposed between the current blocking layer and the second electrode pad, thereby improving structural and electrical reliability of a second electrode.

According to some implementations disclosed in this patent document, the light emitting device has improved wire bonding ability of bonding upon wire bonding to the second electrode of the light emitting device, thereby providing a light emitting device package having good reliability.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A and FIG. **1**B are plan views of a light emitting device according to one exemplary embodiment of the present disclosure.

FIGS. **2**A to **2**C are sectional views of the light emitting device according to the exemplary embodiment of the present disclosure.

FIG. **3**A to FIG. **6**B are enlarged plan views and enlarged sectional views of various modifications of a second electrode, a current blocking layer and a transparent electrode of the light emitting device according to the exemplary embodiment of the present disclosure.

FIG. **7** and FIG. **8** are enlarged plan views of various modifications of a first electrode, a transparent electrode, and an insulation layer of the light emitting device according to the exemplary embodiment of the present disclosure.

FIGS. **9**A and **9**B are plan views of various modifications of a first electrode extension portion and a second electrode extension portion of the light emitting device according to the exemplary embodiment of the present disclosure.

FIG. **10** is a sectional view of a light emitting device according to other exemplary embodiments of the present disclosure.

FIG. **11** is a plan view of the light emitting device according to other exemplary embodiments of the present disclosure.

FIG. **12** is a plan view of a light emitting device according to other exemplary embodiments of the present disclosure.

FIG. **13** is a sectional view of a light emitting device package according to other exemplary embodiments of the present disclosure.

DETAILED DESCRIPTION OF INVENTION

Hereinafter, exemplary embodiments will be described in detail with reference to the accompanying drawings. The following embodiments are provided by way of example so as to facilitate the understanding of the disclosed technology. Accordingly, the present disclosure is not limited to the embodiments disclosed herein and can also be implemented in different forms. When an element is referred to as being "disposed above" or "disposed on" another element, it can be directly "disposed above" or "disposed on" the other element, or intervening elements can be present. Throughout the specification, like reference numerals denote like elements having the same or similar functions. The term "exemplary" is used to mean "an example of" and does not necessarily mean an ideal or a best implementation.

Hereinafter, a light emitting device according to exemplary embodiments of the present disclosure will be described with reference to FIG. **1** (*a*) to FIG. **9**.

FIG. **1**A and FIG. **1**B are plan views of a light emitting device according to one exemplary embodiment of the present disclosure, in which FIG. **1**A shows locations of an enlarged region (a), Line A-A', Line B-B', Line C-C' and Line D-D', and FIG. **1**B shows widths or distances (A**1**, A**2**, A**3**, A**4**, D**1** and D**2**) between components. FIGS. **2**A to **2**C are sectional views taken along Lines A-A', B-B' and C-C' of FIG. **1**A, respectively. FIGS. **3**A and **3**B show an enlarged plan view and an enlarged sectional view of a second electrode of the light emitting device according to the exemplary embodiment of the present disclosure, and FIG. **4**A to FIG. **6**B are enlarged plan views and enlarged sectional views of various modifications of the second electrode of the light emitting device according to the exemplary embodiment of the present disclosure. FIG. **7** is a sectional view of a first electrode of the light emitting device according to the exemplary embodiment of the present disclosure, and FIG. **8** is a sectional view of a modification of the first electrode of the light emitting device according to the exemplary embodiment of the present disclosure. FIGS. **9**A and **9**B are plan views of a first electrode extension portion and a second electrode extension portion of the light emitting device according to the exemplary embodiment of the present disclosure.

Referring to FIG. **1**A to FIG. **9**B, the light emitting device includes a light emitting structure **120**, a current blocking layer **130**, a transparent electrode **140**, a first electrode **150**, and a second electrode **160**. The light emitting device may further include a substrate **110** and an insulation layer **170**. Further, the light emitting device may include first to fourth side surfaces **101**, **102**, **103**, **104**. The light emitting device may have a rectangular shape having different longitudinal and transversal lengths, without being limited thereto.

The substrate **110** may be or include an insulation or conductive substrate. In addition, the substrate **110** may be or include a growth substrate for growth of the light emitting structure **120**, and may include a sapphire substrate, a silicon carbide substrate, a silicon substrate, a gallium nitride substrate, an aluminum nitride substrate, or the like. In other exemplary embodiments, the substrate **110** may be or include a secondary substrate for supporting the light emitting structure **120**. For example, the substrate **110** may be or include a sapphire substrate, for example, a patterned sapphire substrate (PSS), an upper surface of which has a predetermined pattern, and, in this case, the substrate **110** may include a plurality of protrusions **110***p* on the upper surface thereof.

Further, the substrate **110** may include at least one modification region **111** extending from at least one side surface of the substrate **110** in the horizontal direction thereof. The modification regions **111** may be formed in the course of dividing the substrate **110** in order to individualize light emitting devices. For example, the modification regions **111** may be formed by internal processing of the substrate **110** using a stealth laser. Here, a distance from a lowermost modification region **111** to a lower surface of the substrate **110** may be smaller than an uppermost modification region **111** to an upper surface of the substrate **110**. Considering light emitted through the side surfaces of the light emitting device, the modification region **111** may be formed at a relatively lower portion of the substrate **110** by laser processing, thereby further improving extraction efficiency of light generated in the light emitting structure **120**.

In this exemplary embodiment, a first conductive type semiconductor layer **121** will be illustrated as being disposed on the substrate **110**. However, when the substrate **110** is a growth substrate for growth of semiconductor layers **121**, **123**, **125**, the substrate **100** may be removed through a physical and/or chemical process after growth of the semiconductor layers **121**, **123**, **125**.

The light emitting structure **120** may include the first conductive type semiconductor layer **121**, a second conductive type semiconductor layer **125** disposed on the first conductive type semiconductor layer **121**, and an active layer **123** disposed between the first conductive type semiconductor layer **121** and the second conductive type semiconductor layer **125**. Further, the light emitting structure **120** may include a mesa **120***m* disposed on the first conductive type semiconductor layer **121** and including the active layer **123** and the second conductive type semiconductor layer **125**.

The first conductive type semiconductor layer **121**, the active layer **123** and the second conductive type semiconductor layer **125** may be grown in a chamber by a typical method known in the art, such as MOCVD. In addition, the first conductive type semiconductor layer **121**, the active layer **123** and the second conductive type semiconductor layer **125** may include a III-V nitride semiconductor material, for example, a nitride semiconductor material such as (Al, Ga, In)N. The first conductive type semiconductor layer **121** may include n-type dopants (for example, Si, Ge, and Sn), and the second conductive type semiconductor layer **125** may include p-type dopants (for example, Mg, Sr, and Ba), or vice versa. The active layer **123** may include a multi-quantum well (MQW) structure, and the composition ratio of the active layer may be regulated to light in a desired wavelength band. As an example, in this exemplary embodiment, the second conductive type semiconductor layer **125** may be a p-type semiconductor layer.

The mesa **120***m* is placed in some region of the first conductive type semiconductor layer **121** such that the first conductive type semiconductor layer **121** can be exposed in a region in which the mesa **120***m* is not formed. The mesa **120***m* may be formed by partially etching the second conductive type semiconductor layer **125** and the active layer **123**. Although the mesa **120***m* may have any shape without limitation, for example, the mesa **120***m* may be formed along a side surface of the first conductive type semiconductor layer **121**, as shown in the drawings. The mesa **120***m* may have an inclined side surface or a side surface perpendicular to an upper surface of the first conductive type semiconductor layer **121**. In this exemplary embodiment, the mesa **120***m* may include at least one groove **120***g* formed or depressed on the side surface thereof. The grooves **120***g* may be formed along at least one side surface of the light emitting device. For example, a plurality of grooves **120***g* may be formed along the second side surface **102** of the light emitting device, as shown in FIG. **1**A. The plurality of grooves **120***g* may be arranged at substantially constant intervals.

The mesa **120***m* may further include a roughness pattern (not shown) formed on the side surface thereof. In addition, the first conductive type semiconductor layer **121** and the substrate **110** may also further include roughness patterns (not shown) formed on side surfaces thereof. The roughness patterns may be formed by various patterning methods such as dry etching and/or wet etching. Further, the roughness patterns may be formed in an isolation process by which a wafer is divided into individual light emitting devices. With this structure, the light emitting device can have improved light extraction efficiency. It should be understood that other implementations are also possible. For the light emitting device having other structures (for example, a vertical structure) instead of the lateral structure, the upper surface of the first conductive type semiconductor layer **121** may not be exposed.

The current blocking layer **130** is at least partially disposed on the second conductive type semiconductor layer **125**. The current blocking layer **130** may be disposed corresponding to the second electrode **160** on the second conductive type semiconductor layer **125**. The current blocking layer **130** may include a pad-current blocking layer **131** and an extension portion-current blocking layer **133**. The pad-current blocking layer **131** and the extension portion-current blocking layer **133** may be disposed corresponding to a second electrode pad **161** and a second electrode extension portion **163**, respectively. In this structure, the pad-current blocking layer **131** may be disposed adjacent to the first side surface **101** of the light emitting device and the extension portion-current blocking layer **133** may be disposed to extend from the first side surface **101** towards the third side surface **103**, as shown in the drawings.

The current blocking layer **130** can prevent current crowding caused by direct transfer of electric current supplied from the second electrode **160** to the semiconductor layers. Thus, the current blocking layer **130** may exhibit insulation properties and may include an insulation material and be composed of or include a single layer or multiple layers. For example, the current blocking layer **130** may include SiO_x or SiN_x, or may include a distributed Bragg reflector in which insulation materials having different indices of refraction are stacked one above another. The current blocking layer **130** may have light transmittance or light reflectivity, or may have selective light reflectivity.

In some implementation, the current blocking layer **130** may have a larger area than the second electrode **160** formed on the current blocking layer **130**. With this structure, the second electrode **160** may be disposed in a region in which the current blocking layer **130** is formed. Furthermore, the current blocking layer **130** may have an inclined side surface, whereby the risk of peeling or electrically opening the transparent electrode **140** at a corner (that is, an angled portion) of the current blocking layer **130** can be reduced.

The transparent electrode **140** may be disposed on the second conductive type semiconductor layer **125** and covers a portion of an upper surface of the second conductive type semiconductor layer **125** and a portion of the current blocking layer **130**. The transparent electrode **140** may include an opening **140***a* partially exposing the pad-current blocking layer **131**. The opening **140***a* may be disposed on the pad-current blocking layer **131** and the transparent electrode **140** may partially cover the pad-current blocking layer **131**. Furthermore, a side surface of the opening **140***a* may be generally formed along a side surface of the pad-current blocking layer **131**.

The transparent electrode **140** may include a light transmittable and electrically conductive material such as a conductive oxide or light transmittable metal layer. For example, the transparent electrode **140** may include at least one of ITO (indium tin oxide), ZnO (zinc oxide), ZITO (zinc indium tin oxide), ZIO (zinc indium oxide), ZTO (zinc tin oxide), GITO (gallium indium tin oxide), GIO (gallium indium oxide), GZO (gallium zinc oxide), AZO (aluminum-doped zinc oxide), FTO (fluorine tin oxide), or a Ni/Au stack structure. In addition, the transparent electrode **140** may form ohmic contact with the second conductive type semiconductor layer **125**. In this exemplary embodiment, since the second electrode **160** does not directly contact the second conductive type semiconductor layer **125**, electric current can be more effectively spread through the transparent electrode **140**. The transparent electrode **140** will be described below in more detail with reference to FIGS. **3**A and **3**B.

The transparent electrode **140** may include a depression formed around the groove **120***g* of the mesa **120***m*. As shown in an enlarged circle of FIG. **1**A, the depression of the transparent electrode **140** may be formed along the groove **120***g* of the mesa **120***m*. With the structure wherein the transparent electrode **140** includes the depression, an edge line of the transparent electrode **140** may also be formed along an edge line of the mesa **120***m*. With the structure wherein the depression is formed on the transparent electrode **140**, it is possible to prevent electric short due to formation of the transparent electrode **140** on a side surface of the groove **120***g* in fabrication of the light emitting device. In some implementations, as shown in FIGS. **2**A to **2**C, the transparent electrode **140** covers less than an entire surface of the mesa **120***m*. However, other implementations are also possible where the transparent electrode **140** covers the entire surface of the mesa **120***m*.

The second electrode **160** is disposed on the second conductive type semiconductor layer **125** such that at least part of the second electrode **160** is disposed in a region in which the current blocking layer **130** is placed. The second electrode **160** may include a second electrode pad **161** and a second electrode extension portion **163**, which may be disposed on the pad-current blocking layer **131** and the extension portion-current blocking layer **133**, respectively. Thus, part of the transparent electrode **140** may be interposed between the second electrode **160** and the current blocking layer **130**. The second electrode pad **161** may be disposed on the opening **140***a* of the transparent electrode **140**. The second electrode pad **161** may adjoin the transparent electrode **140** and the side surface of the opening **140***a* of the transparent electrode **140** may at least partially adjoin the second electrode pad **161**. The second electrode pad **161** may be disposed so as to allow light emission through an overall surface of the active layer of the light emitting device by efficiently spreading electric current, without being limited thereto. For example, as shown in the drawings, the second electrode pad **161** may be disposed adjacent to the first side surface **101** opposite to the third surface **103** to which the first electrode pad **151** is adjacent.

The second electrode extension portion **163** extends from the second electrode pad **161**. In this exemplary embodiment, the second electrode extension portion **163** may extend from the second electrode pad **161** towards the third side surface **103**. Further, the extension direction of the second electrode extension portion **163** may be changed along the extension of the second electrode extension portion **163**. For example, a distal end of the second electrode extension portion **163** may be bent so as to be directed to a space formed between the third side surface **103** and the fourth side surface **104** of the light emitting device. This structure may be designed in various ways by taking the distance between the first electrode pad **151** and the second electrode extension portion **163** into account. The transparent electrode **140** is interposed between at least part of the second electrode extension portion **163** and the extension portion-current blocking layer **133**, whereby the second electrode extension portion **163** contacts the transparent electrode **140** to be electrically connected thereto.

Further, the second electrode extension portion **163** may include an additional extension portion **163***a* bent or curved in a different direction from the extension direction of the second electrode extension portion **163**. Here, the additional extension portion **163***a* may be bent to be further away from the first electrode extension portion **153**. Furthermore, the additional extension portion **163***a* may be bent towards one corner of the light emitting device, for example, towards a corner between the third side surface **103** and the fourth side surface **104**. As shown in FIG. **1**A, the additional extension portion **163***a* of the second electrode extension portion **163** may have a curved shape having a predetermined radius of curvature. Although a longer length of the second electrode extension portion **163** can provide further improved current spreading efficiency, an excessively short distance from the distal end **163***e* of the second electrode extension portion **163** to the first electrode pad **151** can cause current crowding at the distal end **163***e* of the second electrode extension portion **163**. According to this exemplary embodiment, the second electrode extension portion **163** is bent and the additional extension portion **163***a* is formed in a curved shape having a predetermined radius of curvature, whereby the distance between the second electrode extension portion **163** and the first electrode pad **151** can be maintained at a predetermined value or more. With this structure, the light emitting device can prevent current crowding at the distal end **163***e* of the second electrode extension portion **163**.

Further, the distal end **163***e* of the second electrode extension portion **163** may include a portion, the width of which is greater than an average width of the second electrode extension portion **163**. For example, as shown in FIG. **9**B, the distal end **163***e* of the second electrode extension portion **163** may be formed in a circular shape, the diameter of which is greater than the width of the second electrode extension portion **163**. In this embodiment, the diameter of the distal end **163***e* may be greater than the width of the second electrode extension portion **163** by about 0.5 μm to 5 μm. However, it should be understood that other implementations are also possible and that the shape of the distal end **163***e* of the second electrode extension portion **163** may be modified in various shapes including a polygonal shape, an oval shape, or a circular arc shape, and the like.

With the structure wherein the distal end **163***e* of the second electrode extension portion **163** has a relatively large width, it is possible to improve current spreading around the distal end **163***e* of the second electrode extension portion **163**. Further, the distal end **163***e* of the second electrode extension portion **163** has an enlarged area, thereby effectively preventing failure of the light emitting device due to separation of the second electrode extension portion **163** from the transparent electrode **140** at the distal end **163***e* of the second electrode extension portion **163** while preventing increase in contact resistance at the distal end **163***e* of the second electrode extension portion **163**. Since the second electrode **160** is generally formed through photolithography, there has been a problem in that development can be inefficiently performed around the distal end **163***e* of the second electrode **160**. However, in the structure wherein the distal end **163***e* of the second electrode extension portion **163** has a relatively large area, a process margin can be further provided upon photolithography, thereby preventing failure in the process of forming the second electrode **160**. As a result, the light emitting device can have further improved reliability.

The arrangement of the second electrode **160** is not limited thereto and may be modified and changed in various ways depending upon the shape of the light emitting device.

The second electrode **160** may include a metallic material, for example, Ti, Pt, Au, Cr, Ni, or Al, and the like, and may be composed of a single layer or multiple layers. For example, the second electrode **160** may include at least one of metal stack structures of Ti/Au layers, Ti/Pt/Au layers, Cr/Au layers, Cr/Pt/Au layers, Ni/Au layers, Ni/Pt/Au layers, or Cr/Al/Cr/Ni/Au layers.

Next, referring to FIGS. **3**A and **3**B, an interconnection relationship among the pad-current blocking layer **131**, the transparent electrode **140** and the second electrode pad **161** will be described in more detail.

As shown in FIGS. **3**A and **3**B, the pad-current blocking layer **131** may generally have a circular shape in a plan view. Alternatively, the pad-current blocking layer **131** may be formed in various shapes including a polygonal shape and may be formed in a similar shape corresponding to the second electrode pad **161** in a plan view. The transparent electrode **140** may cover a side surface of the pad-current blocking layer **131** and a portion of an upper surface thereof, for example, around an outer periphery of the pad-current blocking layer **131**. In the structure wherein the transparent electrode **140** partially covers the pad-current blocking layer **131**, a surface profile including an upper surface of the transparent electrode **140** and an upper surface of the pad-current blocking layer **131** may become a rounded or stepped profile instead of a flat profile.

At least part of the opening **140***a* of the transparent electrode **140** may be disposed on the pad-current blocking layer **131**, and in this exemplary embodiment, the shape of the opening **140***a* may correspond to a shape of an outer periphery of the current blocking layer **130**. For example, as shown in FIGS. **3**A and **3**B, in a structure wherein the pad-current blocking layer **131** has a circular shape, the transparent electrode **140** covers a region around the circular periphery thereof such that the opening **140***a* can be formed in a circular shape. The opening **140***a* is formed in a shape corresponding to the shape of the outer periphery of the pad-current blocking layer **131**, thereby preventing the transparent electrode **140** from peeling off the current blocking layer **130**. It should be understood that the opening **140***a* is not limited thereto and may have various shape. In addition, the opening **140***a* may be provided in plural.

Contact resistance between the second electrode pad **161** and the second conductive type semiconductor layer **125** is higher than contact resistance between the transparent electrode **140** and the second conductive type semiconductor layer **125**. Thus, when electric current is supplied through the second electrode pad **161**, the electric current is likely to flow to the transparent electrode **140** having low resistance and can be effectively spread by the transparent electrode **140** in the horizontal direction. Furthermore, in this exemplary embodiment, the second electrode pad **161** does not directly contact the second conductive type semiconductor layer **125**, thereby enabling more effective current spreading.

The second electrode **160** may fill the opening **140***a* to contact the current blocking layer **130** and may further partially cover the transparent electrode **140** disposed on the current blocking layer **130**. Accordingly, the second electrode **160**, particularly, the second electrode pad **161** contacts the transparent electrode **140**. Here, a horizontal area of the second electrode pad **161** may be larger than the area of the opening **140***a* of the transparent electrode **140**, whereby the opening **140***a* can be covered by the second electrode pad **161**. As shown in FIGS. **3**A and **3**B, the second electrode pad **161** may be formed in a circular shape having a radius R**1** and the opening **140***a* of the transparent electrode **140** may be formed in a circular shape having a radius R**2**. R**1** is larger than R**2**. The sizes of R**1** and R**2** may be adjusted to provide a region for sufficient wire bonding and to prevent separation of the second electrode pad **161** and the transparent electrode **140**. R**1** may be larger than R**2** by about 5 μm to 15 μm. For example, the second electrode pad **161** may have a radius R**1** of about 35 μm and the opening **140***a* of the transparent electrode **140** may have a radius R**2** of about 25 μm. In some implementations, the difference between R**1** and R**3** is a little bit smaller than the difference between R**1** and R**2**.

The second electrode pad **161** may be formed to have a non-planar upper surface. For example, the upper surface of the second electrode pad **161** may have a surface profile corresponding to the surface profile of the upper surface of the transparent electrode **140** and the upper surface of the pad-current blocking layer **131**. That is, the second electrode pad **161** may be disposed on the transparent electrode **140** and the pad-current blocking layer **131**, which have non-flat surface profiles, and thus have a rounded or stepped surface. As shown in FIGS. **3**A and **3**B, the upper surface of the second electrode pad **161** may include at least one depression **161***g* disposed in a region in which the opening **140***a* is placed. As a result, the upper surface of the second electrode pad **161** may have a stepped surface. In some implementations, the depression **161***g* may be formed in a circular shape as shown in FIG. **3**A. Accordingly, in the structure wherein the second electrode pad **161** is formed in a circular shape, the outer periphery of the second electrode pad **161** and the periphery of the depression **161***g* may be formed in concentric circle shapes.

In the structure wherein the second electrode pad **161** has a non-flat surface profile, bondability between a wire and the second electrode pad **161** can be improved upon wire bonding the upper surface of the second electrode pad **161**. With this structure, the light emitting device can effectively prevent disconnection of the wire in a region in which the wire is bonded to the second electrode pad **161**. Further, the second electrode pad **161** is disposed on the transparent electrode **140** and the pad-current blocking layer **131**, which have the non-flat surface profiles, thereby preventing the second electrode pad **161** from being peeled off the current blocking layer **130** and/or the transparent electrode **140**. That is, since the second electrode pad **161** can be more stably disposed in the structure wherein the second electrode pad **161** is formed on a stepped or rounded surface than in the structure wherein the second electrode pad **161** is formed in a flat surface, the second electrode pad **161** is prevented from being peeled off therefrom. Furthermore, since a portion of the transparent electrode **140** is interposed between the pad-current blocking layer **131** and the second electrode pad **161**, the transparent electrode **140** can be more stably disposed, thereby preventing separation of the transparent electrode **140**. Accordingly, structural stability among the second electrode **160**, the current blocking layer **130** and the transparent electrode **140** can be improved.

FIG. **4**A to FIG. **6**B are plan views and sectional views of a current blocking layer, a transparent electrode and a second electrode according to various exemplary embodiment of the present disclosure. In the following exemplary embodiments, reference numerals of components will be denoted with different hundreds digits. For example, in FIGS. **3**A and **3**B, the current blocking layer is denoted by **130**, whereas in FIGS. **4**A and **4**B, the current blocking layer will be denoted by **230**. This is provided for convenience of description and physical characteristics of each component are the same as those of the corresponding component described above.

First, referring to FIGS. **4**A and **4**B, according to this exemplary embodiment, a transparent electrode **240** may include a first opening **240***a* and a pad-current blocking layer **231** may include a second opening **231***a* exposing the second conductive type semiconductor layer **125**. Accordingly, a second electrode pad **261** contacts the second conductive type semiconductor layer **125** through the second opening **231***a*.

The second opening **231***a* may be disposed in a region in which the first opening **240***a* is placed, and the transparent electrode **240** may cover an outer peripheral region of the pad-current blocking layer **231**. Accordingly, a stepped surface profile including an upper surface of the transparent electrode **240**, an upper surface of the pad-current blocking layer **231**, and an upper surface of the second conductive type semiconductor layer **125** under the second opening **231***a* is formed. Accordingly, the upper surface of the second electrode pad **261** may include a first depression **261***ga* disposed corresponding to the first opening **240***a* and a second depression **261***gb* disposed corresponding to the second opening **231***a*.

In this exemplary embodiment, a horizontal area of the second electrode pad **261** may be larger than the area of the first opening **240***a* of the transparent electrode **240** and a horizontal area of the first opening **240***a* may be larger than that of the second opening **231***a*. Accordingly, the openings **240***a*, **231***a* may be covered by the second electrode pad **261**. As shown in FIGS. **4** A and **4**B, the second electrode pad **261** may be formed in a circular shape having a radius R**1**, the first opening **240***a* of the transparent electrode **240** may be formed in a circular shape having a radius R**2**, and the second opening **231***a* may be formed in a circular shape having a radius R**3**. Here, R**1** is greater than R**2**, which is greater than R**3**. The sizes of R**1** to R**3** may be adjusted to provide a region for sufficient wire bonding and to prevent separation of the second electrode pad **261** and the transparent electrode **240**.

As the pad-current blocking layer **231** includes the second opening **231***a*, more steps and curves are formed on the upper surface of the second electrode pad **261**. With this structure, the second electrode pad **261** can be more stably disposed and allows a wire to be more stably bonded thereto upon wire bonding.

Next, referring to FIGS. **5**A and **5**B, in this exemplary embodiment, a transparent electrode **340** includes a first opening **340***a* and a pad-current blocking layer **331** may include a second opening **331***a* exposing the second conductive type semiconductor layer **125**. Further, the transparent electrode **340** may cover the pad-current blocking layer **331**. As shown in FIGS. **5**A and **5**B, the transparent electrode **340** may cover a side surface of the second opening **331***a* of the pad-current blocking layer **331**. Accordingly, a second electrode pad **361** may contact the second conductive type semiconductor layer **125** through the second opening **331***a* and the first opening **340***a*.

An upper surface of the second electrode pad **361** may include a depression **361***g* disposed corresponding to the first opening **340***a*. According to this exemplary embodiment, the pad-current blocking layer **331** includes the second opening **331***a* while covered by the transparent electrode **340**. Thus, the upper surface of the second electrode pad **361** may include a depression **361***g*, the depth of which is greater than the thickness of the pad-current blocking layer **331**. In addition, the depression **361***g* of the second electrode pad **361** is deeper than the depression shown in FIGS. 3A and 3B.

Furthermore, as shown in FIGS. **5**A and **5**B, the second electrode pad **361** may be formed in a circular shape having a radius R**1**, the first opening **340***a* of the transparent electrode **340** may be formed in a circular shape having a radius R**2**, and the second opening **331***a* may be formed in a circular shape having a radius R**3**. Here, R**1** is larger than R**2**, which is larger than R**3**. The sizes of R**1** to R**3** may be adjusted to provide a region for sufficient wire bonding and to prevent separation of the second electrode pad **361** and the transparent electrode **340**.

Referring to FIGS. **6**A and **6**B, a pad-current blocking layer **431** may include a second opening **431***a* exposing the second conductive type semiconductor layer **125**, a first portion **4311** surrounded by the second opening **431***a*, and a second portion **4312** surrounding the second opening **431***a*. A transparent electrode **440** may partially cover an outer peripheral region of the second portion **4312** of the pad-current blocking layer **431**. In this exemplary embodiment, an upper surface of the second portion **4312** is partially exposed. Accordingly, a surface profile, in which an upper surface of a transparent electrode **440**, an upper surface of the second portion **4312** of the pad-current blocking layer **431**, an upper surface of the second conductive type semiconductor layer **125** under the second opening **431***a*, and the upper surface of the first portion **4311** have steps, is formed. Accordingly, an upper surface of a second electrode pad **461** may include a first depression **461***ga* disposed corresponding to the first opening **440***a*, a second depression **461***gb* disposed corresponding to the second opening **431***a*, and a protrusion **461***p* disposed corresponding to the first portion **4311**.

As the pad-current blocking layer **431** includes the first portion **4311** surrounded by the second opening **431***a* and the second opening **431***a*, more steps and curves are formed on the upper surface of the second electrode pad **461**. With this structure, the second electrode pad **461** can be more stably disposed and allows a wire to be more stably bonded thereto upon wire bonding.

On the other hand, in the exemplary embodiments of FIG. **4**A to FIG. **6**B, each of the second electrodes **260**, **360**, **460** may contact the second conductive type semiconductor layer **125**. Here, a lower surface of each of the second electrodes **260**, **360**, **460** may be formed such that poor ohmic contact is formed between each of the second electrodes **260**, **360**, **460** and the second conductive type semiconductor layer **125** and high contact resistance is formed at an interface therebetween. For example, each of the second electrodes **260**, **360**, **460** may be formed in a multilayer structure, the lowermost layer of which is formed of a material forming poor ohmic contact with the second conductive type semiconductor layer **125**. Accordingly, upon application of electric current, the electric current flows to the transparent electrode **240**, **340** or **440** having a relatively low resistance at an interface thereof, thereby preventing reduction in current spreading efficiency.

Although various structures of the second electrode, the transparent electrode, and the current blocking layer according to various exemplary embodiments have been described above, it should be understood that other implementations are also possible.

Referring to FIG. **1**A to FIG. **3**B again, the first electrode **150** is electrically connected to the first conductive type semiconductor layer **121**. The first electrode **150** may form ohmic contact with and be electrically connected to the exposed upper surface of the first conductive type semiconductor layer **121**, which is exposed by partially removing the second conductive type semiconductor layer **125** and the active layer **123**. The first electrode **150** may include a first electrode pad **151** and a first electrode extension portion **153**. The first electrode extension portion **153** includes at least one extension portion-contact portion **153***a*. The extension portion-contact portion **153***a* may form ohmic contact with the first conductive type semiconductor layer **121**. In this exemplary embodiment, parts of the first electrode pad **151** and the first electrode extension portion **153** may be disposed on the mesa **120***m*, and the insulation layer **170** may be interposed between the mesa **120***m* and part of the first electrode **150**.

The first electrode **150** can act as a path through which electric power is supplied from an external power source to the first conductive type semiconductor layer **121** and may include a metallic material such as Ti, Pt, Au, Cr, Ni, or Al, and the like. In addition, the first electrode **150** may be composed of a single layer or multiple layers.

The first electrode pad **151** may be disposed near the third side surface **103** of the light emitting device and the first electrode extension portion **153** may extend towards the first side surface **101** along the third side surface **103** and the second side surface **102**. Generally, in a light emitting device having a rectangular shape, the first electrode pad is formed in a corner region of the light emitting device. However, in the structure wherein the first electrode pad is formed in the corner region of the light emitting device, part of a lead frame can be damaged upon ball bonding or wire bonding. Thus, as in this exemplary embodiment, the first electrode pad **151** is formed in a central region of the light emitting structure **120**, thereby improving process efficiency in bonding and packaging.

Here, in order to improve process efficiency by securing a suitable level of process margin upon packaging, the first electrode pad **151** may be separated from the outer side surface of the light emitting structure **120** by at least 50 μm or more. However, if the first electrode pad **151** is excessively separated from the outer side surface of the light emitting structure **120**, the light emitting device can suffer from deterioration in luminous efficacy in an outer peripheral region of the light emitting structure **120**. Thus, the first electrode pad **151** is preferably separated from outer side surface of the light emitting structure **120** by about 50 μm to about 200 μm. However, it should be understood that other implementations are also possible.

The insulation layer **170** may be interposed between the light emitting structure **120** and the first electrode **150**, and may include an opening **170***a* which partially exposes the first conductive type semiconductor layer **121** exposed through the groove **120***g* of the mesa **120***m*.

As shown in FIG. **1**A, part of the insulation layer **170** is disposed under the first electrode pad **151** to electrically insulate the first electrode pad **151** from the second conductive type semiconductor layer **125**. In addition, the insulation layer **170** disposed under the first electrode pad **151** may have a larger area than the first electrode pad **151** and may cover a side surface of the light emitting structure **120**. With this structure, the light emitting device can effectively prevent occurrence of short circuit between the first electrode pad **151** and the second conductive type semiconductor layer **125** and short circuit which can occur upon wire bonding to the first electrode pad **151**.

In one exemplary embodiment, as shown in FIG. **7**, the insulation layer **170** disposed under the first electrode pad **151** may be separated from the transparent electrode **140**. In this case, current leakage caused by defects in the insulation layer **170** can be prevented from flowing to the transparent electrode **140**. In other exemplary embodiments, as shown in FIG. **8**, the insulation layer **170** disposed under the first electrode pad **151** may adjoin the transparent electrode **140** while partially covering the side surface and the upper surface of the transparent electrode **140**. With this structure, it is possible to prevent short circuit that can occur when a bonding material flows along the side surface of the first electrode pad **151** and contacts the transparent electrode **140** upon bonding to the upper surface of the first electrode pad **151**.

The opening **170***a* of the insulation layer **170** can at least partially expose the groove **120***g*. The extension portion-contact portion **153***a* is disposed in a region of the first conductive type semiconductor layer **121** exposed through the opening **170***a* and the groove **120***g* of the mesa **120***m* to be electrically connected to the first conductive type semiconductor layer **121** in the region thereof. Further, the insulation layer **170** partially covers the side surface of the groove **120***g* to prevent occurrence of short circuit caused by contact between the first electrode extension portion **153** and the side surface of the light emitting structure **120**.

In this way, the first electrode pad **151** does not directly contact the first conductive type semiconductor layer **121** and the extension portion-contact portion **153***a* of the first electrode extension portion **153** contacts the first conductive type semiconductor layer **121** to form electrical connection, thereby enabling efficient current spreading in the horizontal direction upon operation of the light emitting device. In a structure wherein the first electrode **150** is an n-type electrode, electrons are injected from the first electrode **150**. Here, in a structure wherein the entirety of the first electrode extension portion **153** contacts the first conductive type semiconductor layer **121**, electron density supplied to the first conductive type semiconductor layer **121** can vary depending upon a distance from the first electrode pad **151**. In this case, current spreading efficiency can be deteriorated. Conversely, according to this exemplary embodiment, the first electrode extension portion **153** contacts the first conductive type semiconductor layer **121** through the extension portion-contact portion **153***a* thereof and other portions of the first electrode extension portion **153** are insulated from the first conductive type semiconductor layer **121** by the insulation layer **170**. Accordingly, electrons are injected into the light emitting device through the extension portion-contact portion **153***a*, whereby electron injection density can be generally kept similar in a plurality of extension portion-contact portions **153***a*. Accordingly, electrons can be efficiently injected into the light emitting device through a portion of the first electrode extension portion **153** relatively far apart from the first electrode pad **151**, thereby improving current spreading efficiency of the light emitting device.

Referring to FIG. **1**B, a width of a contact portion between the extension portion-contact portion **153***a* of the first electrode extension portion **153** and the first conductive type semiconductor layer **121**, that is, a width D**1** of the opening **170***a* of the insulation layer **170**, may be smaller than a distance D**2** between the openings **170***a* of the insulation layer **170**. Furthermore, the distance D**2** between the openings **170***a* may be adjusted so as to be three or more times the width D**1** of the opening **170***a*, thereby further improving performance of spreading electric current supplied through the extension portion-contact portion **153***a*.

Further, a distal end **153***e* of the first electrode extension portion **153** may include a portion, the width of which is greater than an average width of the first electrode extension portion **153**. For example, as shown in FIG. **9**A, the distal end **153***e* of the first electrode extension portion **153** may be formed in a circular shape, the diameter of which is greater than the width of the first electrode extension portion **153**. In this exemplary embodiment, the diameter of the distal end **153***e* may be greater than the width of the first electrode extension portion **153** by about 0.5 μm to about 5 μm. However, it should be understood that other implementations are also possible and that the shape of the distal end **153***e* of the first electrode extension portion **153** may be modified into various shapes including a polygonal shape, an oval shape, or a circular arc shape, and the like.

With the structure wherein the distal end **153***e* of the first electrode extension portion **153** has a relatively large width, it is possible to improve current spreading around the distal end **153***e* of the first electrode extension portion **153**. Further, the distal end **153***e* of the first electrode extension portion **153** has an enlarged area, thereby effectively preventing failure of the light emitting device due to separation of the first electrode extension portion **153** near the distal end **153***e* of the first electrode extension portion **153**. Since the first electrode **150** is generally formed through photolithography, there has been a problem in that development can be inefficiently performed around the distal end **153***e* of the first electrode **150**. However, in the structure wherein the distal end **153***e* of the first electrode extension portion **153** has a relatively large area, a process margin can be further provided upon photolithography, thereby preventing failure in the process of forming the first electrode **150**. As a result, the light emitting device can have further improved reliability.

On the other hand, the arrangement of the first electrode **150** and the second electrode **160** is not limited thereto and may be modified and changed in various ways depending upon the shape of the light emitting device. The arrangement of the first electrode pad **151** and the first electrode extension portion **153** may be changed depending upon the arrangement of the second electrode pad **161** and the second electrode extension portion **163**.

For example, referring to FIG. **1**B, a distance A**1** from the first electrode extension portion **153** extending along the second side surface **102** of the light emitting device to the second electrode extension portion **163** is greater than a distance A**2** from the distal end **163***e* of the second electrode extension portion **163** to the first electrode pad **151**. The second electrode extension portion **163** extends towards the first electrode pad **151** while maintaining a constant distance from the second electrode extension portion **163** to the first electrode extension portion **153** extending along the second side surface **102**, thereby improving current spreading efficiency. In addition, the distance A**2** is set to be less than the distance A**1**, whereby current density near the distal end of the second electrode extension portion **163** is reduced, thereby preventing deterioration in current spreading efficiency.

Furthermore, a distance A**3** from the distal end **163**e of the second electrode extension portion **163** to the outer periphery of the transparent electrode **140** (the periphery along the fourth side surface **104**) may be substantially the same as a distance from the side surface of the second electrode pad **161** to the outer periphery of the transparent electrode **140** (the periphery along the fourth side surface **104**). Here, the distance A**3** may be about 50 μm to 60 μm.

Furthermore, the second electrode extension portion **163** may be biased to the fourth side **104** of the light emitting device rather than the second side surface **102** thereof. As shown in the drawings, the second electrode extension portion **163** is closer to the fourth side **104** of the light emitting device than the second side surface **102** and may be separated from a longitudinal central line CL passing through the center of the light emitting device by a distance A**4**. The distance A**4** may range from about 14 μm to 18 μm. Since the first electrode extension portion **153** is disposed near the second side surface **102**, the second electrode extension portion **163** may be disposed closer to the fourth side surface **104** than the second side surface **102** in order to improve current spreading.

FIG. **10** is a sectional view of a light emitting device according to another exemplary embodiment of the present disclosure. The light emitting device shown in FIG. **10** is generally similar to the light emitting device described with reference to FIG. **1**A to FIG. **9**B except that the light emitting device according to this exemplary embodiment further includes a reflective layer **510** disposed below the light emitting structure **120**. The following description will focus on the different features of the light emitting device according to this exemplary embodiment, and detailed descriptions of the same components will be omitted.

Referring to FIG. **10**, the light emitting device includes a light emitting structure **120**, a current blocking layer **130**, a transparent electrode **140**, a first electrode **150**, a second electrode **160**, and a reflective layer **510**. In addition, the light emitting device may further include a substrate **110** and an insulation layer **170**. The light emitting device may include first to fourth side surfaces **101**, **102**, **103**, **104**.

The reflective layer **510** may be disposed below the light emitting structure **120**, and in the structure wherein the light emitting device further includes the substrate **110**, the reflective layer may be disposed under the substrate **110**. The reflective layer **510** may be formed of a light reflective material to reflect light emitted from the light emitting structure **120**.

The reflective layer **510** may include a distributed Bragg reflector in which dielectric layers having different indices of reflection are stacked one above another. In this exemplary embodiment, the reflective layer **510** may include a stack structure **511** in which a first dielectric layer having a first index of refraction and a second dielectric layer having a second index of refraction are repeatedly stacked one above another, and an interface layer **513** formed on an upper surface of the stack structure **511**. The interface layer **513** can serves as a bonding layer on which the stack structure **511** can be formed, while improving interfacial characteristics of the first and second dielectric layers of the stack structure **511**. Accordingly, the interface layer **513** may be formed to have a thicker thickness than each of the dielectric layers of the stack structure **511**.

For example, the first dielectric layer may include TiO_2 or may be formed of TiO_2, and the second dielectric layer may include SiO_2 or may be formed of SiO_2. Further, the interface layer **513** may include SiO_2 or may be formed of SiO_2. In this structure, among the layers of the stack structure **511**, a dielectric layer adjoining the interface layer **513** may be the first dielectric layer. Accordingly, when the entirety of the reflective layer **510** is taken into account, the reflective layer **510** may have a stack structure of different material layers. However, it should be understood that other implementations are also possible.

In the structure wherein the reflective layer **510** is disposed under the substrate **110**, a lower surface of the substrate **110** may have an RMS roughness of 100 nm or less. This structure can be obtained through a surface planarization process known in the art. For example, the RMS roughness of the lower surface of the substrate **110** may be controlled by chemical mechanical polishing (CMP). As the lower surface of the substrate **110** has an RMS roughness of 100 nm or less, it is possible to prevent deterioration in bonding strength or generation of cracks on the reflective layer **510** caused by unbalance of the first dielectric layer or the second dielectric layer caused by the substrate **110** having high surface roughness upon heat treatment at high temperature.

The reflective layer **510** may further include a layer formed of a light reflective metal, or may be formed of the light reflective metal instead of the stack structure **511**. Here, the layer formed of the light reflective metal may be composed of a single layer or multiple layers, and may include Al, Au, or Pt, and the like.

FIG. **11** is a plan view of a light emitting device according to another exemplary embodiment of the present disclosure. The light emitting device shown in FIG. **11** is generally similar to the light emitting device described with reference to FIG. **1**A to FIG. **9**B. The following description will focus on the different features of the light emitting device according to this exemplary embodiment, and detailed descriptions of the same components will be omitted.

The light emitting device according to this exemplary embodiment includes a light emitting structure **120**, a current blocking layer **130**, a transparent electrode **140**, a first electrode **150**, and a second electrode **160**. In addition, the light emitting device may further include a substrate **110**, an insulation layer **170**, and a reflective layer **510**. The light emitting device may include first to fourth side surfaces **101**, **102**, **103**, **104**. The light emitting device may have a rectangular shape having different longitudinal and transversal lengths, without being limited thereto.

According to this exemplary embodiment, the light emitting device includes a mesa **120**m including a groove **120**g' having a circular arc shape in a plan view. The groove **120**g' is more depressed from the side surface of the mesa **120**m than the groove **120**g shown in FIG. **1**A. Accordingly, the distance from the extension portion-contact portion **153**a to the transparent electrode **140** may be greater than that of the light emitting device shown in FIG. **1**A to FIG. **9**B. Accordingly, the light emitting device according to this exemplary embodiment can effectively prevent short circuit which can occur near the extension portion-contact portion **153**a. Further, the width of a contact portion between the extension portion-contact portion **153**a and the first conductive type semiconductor layer **121** may be greater than that of the light emitting device shown in FIG. **1**A to FIG. **9**B.

Furthermore, a distance A**2**' from the distal end **163**e of the second electrode extension portion **163** to the first electrode pad **151** may be greater than that of the light emitting device shown in FIG. **1**A to FIG. **9**B, and a distance A**3**' from the distal end **163**e of the second electrode extension portion **163** to the outer periphery of the transparent electrode **140** (the periphery along the fourth side surface **104**) may be smaller than that of the light emitting device shown in FIG. **1**A to FIG. **9**B. Referring to FIG. **11**, the distance A**3**' is smaller than the distance A**2**' but other implementations are also possible.

That is, as in this exemplary embodiment, the shape and size of the groove **120***g*' of the mesa **120***m*, and the arrangement of the first and second electrodes **150**, **160** may be modified so as to further improve current spreading efficiency depending upon drive current of the light emitting device.

FIG. **12** is a plan view of a light emitting device according to other exemplary embodiments of the present disclosure. The second electrode extension portion **163** and the first electrode extension portion **153** may have same or different width from each other. The center of the first electrode pad **151** is disposed closer to a right edge of the light emitting device than that of the second electrode pad **161**. The light emitting device shown in FIG. **12** is generally similar to the light emitting device described with reference to FIG. **1**A to FIG. **9**B. The following description will focus on the different features of the light emitting device according to this exemplary embodiment, and detailed descriptions of the same components will be omitted.

The light emitting device according to this exemplary embodiment includes a light emitting structure **120**, a current blocking layer **130**, a transparent electrode **140**, a first electrode **150**, and a second electrode **160**. In addition, the light emitting device may further include a substrate **110**, an insulation layer **170**, and a reflective layer **510**. The light emitting device may include first to fourth side surfaces **101**, **102**, **103**, **104**. The light emitting device may have a rectangular shape having different longitudinal and transversal lengths, without being limited thereto.

According to this exemplary embodiment, the first electrode **150** is disposed on the first conductive type semiconductor layer **121**. That is, the first electrode **150** may be disposed adjacent to a side surface of a mesa **120***m* instead of being disposed on the mesa **120***m*. The insulation layer **170** may be partially interposed between the first electrode **150** and the first conductive type semiconductor layer **121**. Further, the insulation layer **170** may include two or more openings **170***a* exposing part of the first conductive type semiconductor layer **121**. In this exemplary embodiment, the first electrode extension portion **153** includes a first extension portion-contact portion **153***a* and a second extension portion-contact portion **153***b*. The first the extension portion-contact portion **153***a* may contact the first conductive type semiconductor layer **121** through the openings **170***a* formed along a long side surface of the mesa **120***m*. The second extension portion-contact portion **153***b* may be disposed adjacent to the first electrode pad **151** and may form ohmic contact with the first conductive type semiconductor layer **121** exposed to the side surface of the mesa **120***m*. In this exemplary embodiment, the second extension portion-contact portion **153***b* may be disposed near a corner of the mesa **120***m*. As such, in addition to the first the extension portion-contact portion **153***a*, the second extension portion-contact portion **153***b* is formed to contact the first conductive type semiconductor layer **121**, thereby further improving current spreading in a region near the first electrode pad **151**.

FIG. **13** is a sectional view of a light emitting device package according to other exemplary embodiments of the present disclosure.

Referring to FIG. **13**, a light emitting device package **600** includes a light emitting device **100**, a first lead **631** and a second lead **633** electrically connected to the light emitting device **100**, and wires **611**, **613**. In addition, the light emitting device package **600** may further include a base **620** and a reflector **623**.

The light emitting device **100** may be mounted on the base **620**, particularly, on the second lead **633** or the first lead **631**. In this exemplary embodiment, the light emitting device **100** may be surrounded by the reflector **623** formed along a side surface of the base **620**, and the reflector **623** has an inclined surface to reflect light, thereby improving luminous efficacy of the light emitting device package.

The light emitting device **100** may be one of the light emitting devices according to the exemplary embodiments described with reference to FIG. **1**A to FIG. **12** or a light emitting device obtained through modification thereof. As described above, the second electrode pad **161** of the light emitting device **100** has a non-flat surface profile, and for example, includes a depression **161***g* corresponding to the opening **140***a*. The second electrode pad **161** is electrically connected to the second lead **633** through the second wire **613**.

In this exemplary embodiment, the second wire **613** may be electrically connected to the second electrode pad **161** through ball bonding. As shown in FIG. **13**, upon ball bonding of the second wire **613** to the second electrode pad **161**, the second wire **613** can be stably bonded to the second electrode pad **161** by the depression **161***g* formed on the surface of the second electrode pad **161**. Accordingly, it is possible to improve reliability of the light emitting device package by preventing wire contact failure upon packaging of the light emitting device while preventing disconnection of wires caused by internal/external factors even after manufacture of the light emitting device package.

Furthermore, the light emitting device has good current spreading efficiency, thereby securing good efficiency even under high current driving conditions. Accordingly, the light emitting device package including the light emitting device can also be used for high current driving applications.

Although some exemplary embodiments have been described above, it should be understood that these embodiments are given by way of illustration only, and that various modifications, variations, and alterations can be made without departing from the spirit and scope of the present disclosure.

The invention claimed is:

1. A light emitting device comprising:

a substrate;

a first semiconductor layer formed over the substrate;

a mesa including an active layer formed over the first semiconductor layer and exposing a portion of the first semiconductor layer and

a second semiconductor layer formed over the active layer;

an electrode formed over a first region of the second semiconductor layer;

an insulation layer formed over a second region of the second semiconductor layer and extended to contact the portion of the first semiconductor layer, the insulation layer having a portion located on a sidewall of the mesa and having a varying width along the sidewall of the mesa;

a first pad formed over the insulation layer and electrically coupled to the first semiconductor layer;

a second pad formed over the electrode and electrically coupled to the second semiconductor layer; and

a first electrode extension extended from the first pad, and

a pad-current blocking layer disposed between the second pad and the second semiconductor layer, wherein the insulation layer includes a portion that extends under the first electrode extension, the portion of the insulation layer has a greater width than a width of the first electrode extension,

the portion of the insulation under the first electrode extension exposes a portion of a sidewall of mesa, and

wherein the electrode includes a first opening disposed on the pad-current blocking layer and the pad-current blocking layer includes a second opening exposing the second conductive type semiconductor layer and disposed in the first opening, the second pad contacting the second conductive type semiconductor layer through the second opening, and an upper surface of the second pad comprises a first depression disposed to correspond to the first opening and a second depression disposed to correspond to the second opening.

2. The light emitting device of claim **1**, wherein the insulation layer has a greater width than a width of the first pad.

3. The light emitting device of claim **1**, wherein a portion of the insulation layer disposed under the first pad has a width greater than the portion of the insulation layer disposed under the first electrode extension.

4. The light emitting device of claim **1**, wherein the insulation layer covers a side surface of the active layer and the second semiconductor layer.

5. The light emitting device of claim **1**, wherein a portion of the insulation layer disposed under the first pad is separated from the electrode by a predetermined distance.

6. The light emitting device of claim **1**, wherein a portion of the insulation layer disposed under the first pad partially covers a side surface and an upper surface of the electrode.

7. The light emitting device of claim **1**, wherein the insulation layer is separated from the electrode.

8. A light emitting device comprising:

a substrate having a first to fourth side surfaces, the first side surface opposite to the third side surface and the second side surface opposite to the fourth side surface;

a light emitting structure formed over the substrate and including a first semiconductor layer, an active layer and a second semiconductor layer;

an electrode formed over the second semiconductor layer and electrically contacting the second semiconductor layer;

a first pad formed over the light emitting structure and disposed closer to the first side surface than the third side surface, the first pad electrically contacting the first semiconductor layer;

a second pad formed over the light emitting structure and disposed closer to the third side surface than the first side surface, the second pad electrically contacting the electrode;

a first electrode extension extended from the first pad toward the third side surface;

a second electrode extension extended from the second pad toward the first side surface; and

an insulation layer formed between the first pad and the second semiconductor layer and extended to contact the first semiconductor layer, wherein the light emitting device further wherein the light emitting device further comprises a pad-current blocking layer disposed between the second pad and the second semiconductor layer, wherein the electrode includes a first opening disposed on the pad-current blocking layer and the pad-current blocking layer includes a second opening exposing the second conductive type semiconductor layer and disposed in the first opening, the second pad contacting the second conductive type semiconductor layer through the second opening, and an upper surface of the second pad comprises a first depression disposed to correspond to the first opening and a second depression disposed to correspond to the second opening.

9. The light emitting device of claim **8**, wherein the insulation layer includes openings at constant intervals along the second side surface, the openings exposing the first semiconductor layer.

10. The light emitting device of claim **8**, wherein the insulation layer extends under the first electrode extension.

11. The light emitting device of claim **10**, wherein the insulation layer disposed under the first electrode extension has a greater width than a width of the first electrode extension.

12. The light emitting device of claim **10**, wherein a portion of the insulation layer disposed under the first pad has a width greater than the insulation layer disposed under the first electrode extension.

13. The light emitting device of claim **10**, wherein the second electrode extension has an end portion with a width greater than an average width of the second electrode extension.

14. The light emitting device of claim **8**, wherein the insulation layer has a greater width than a width of the first pad.

15. The light emitting device of claim **8**, wherein the light emitting structure is structured to expose the first semiconductor layer through a groove formed at one side of the light emitting structure.

16. The light emitting device of claim **15**, wherein the first pad is without a direct electrical connection with the first semiconductor layer and electrically contacts the first semiconductor layer through the first electrode extension.

17. The light emitting device of claim **15**, wherein the first electrode extension includes a first portion electrically contacting the first semiconductor layer and a second portion insulated from the first semiconductor layer.

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